JULY, 1933

7TH TIER

25 Cents, $1 a Year

Contractors and Engineers Monthly

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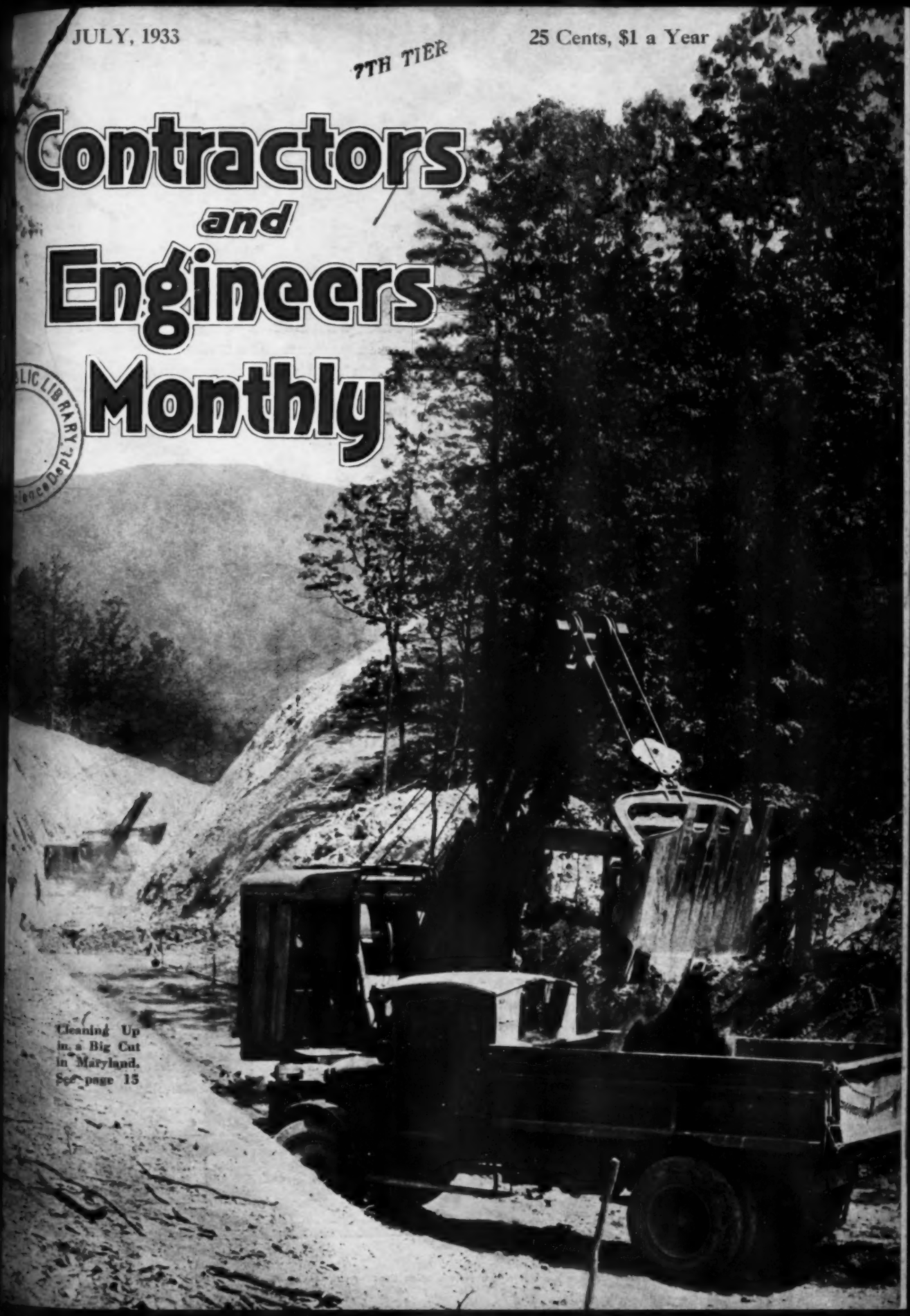


Cleaning Up in a Big Cut in Maryland. See page 15

EUCLIDS move 176,000 yds. of Gumbo in One Month . . .

RAMEY & MOORE featured their Chatham, Mississippi levee job by moving 176,000 cu. yds. of gumbo in one month, with Euclid "12 yard" wagons. This firm's profitable satisfaction with Euclid performance and economy is fully proved by their repeat purchases during the 1932 season. Six of these giant dirt-movers were shipped South on May 7th—One more followed on the 21st of June—Another left on August 17th and on October 19th the ninth "12 yard" was on its way to round out another exclusive Euclid Fleet. This proof of Economy and Service should interest every contractor. Get the facts about Euclid before you buy.

Euclid Permo-Arch "Track-Wheels", with the drop-forged hooks, are important factors in the wide spread satisfaction of Euclid Wagons. If you intend to "retrack" we will gladly send complete information about Permo-Arch construction and performance; plus costs as per your requirements. These "Track-Wheels" fit all makes of crawler wagons.

JOB FACTS

CONTRACTORS . . Ramey & Moore

Type of Job - - Levee construction at Chatham, Miss.

Size of Job - - 500,000 cu. yds.

Equipment - - P. & H. Draglines—"Caterpillar" Tractors—Six "12 yard" Euclid Wagons.

FACTS - - Job operations were started on May 12th, 1932 and finished four months later on August 15th. Five "12 yards" were used on the first three month's work with the sixth unit added during the fourth and final month.

THE EUCLID ROAD MACHINERY COMPANY

CLEVELAND OHIO

The 30-Hour Labor Problem

How Contractors Are Handling Two and Three Shifts to Give Maximum Employment

CONTRACTORS are faced with a real Chinese puzzle on projects financed with federal money on which it is required that labor, with the exception of executives and superintendents, shall not be employed more than 30 hours per week. No highway project can be worked profitably for only 30 hours a week, thus at least two shifts are necessary and on some types of work, such as lock construction, work is pushed 24 hours a day. We have made a special study of how various contractors are handling this 30-hour problem in Pennsylvania, Ohio, Indiana and Kentucky and are recording here some of the schemes which have been used and found satisfactory.

Three 8-Hour Shifts a Day

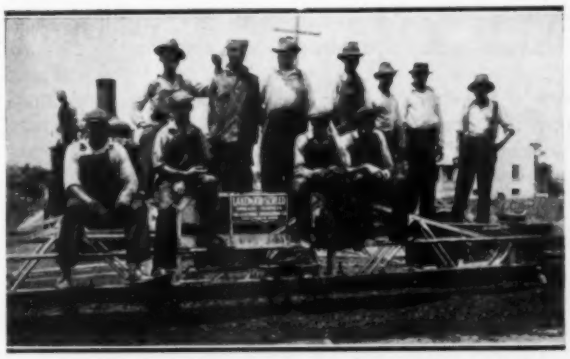
Where lock and dam work is under way, it is necessary to work 24 hours a day and this means three 8-hour shifts, but working a man even 5 days a week runs up his time beyond the 30-hour limit. On an Allegheny River lock project, the contractor used his men for three 8-hour shifts during the week and one split shift. The balance of labor on the various shifts was maintained by laying off men at various times during the week when certain operations were not going forward intensively and by not working all types of laborers on every shift or every day.

Another nearby lock project handled the labor problem much the same way and had warning signs at the timekeeper's office, stating that any man who reported for two consecutive 8-hour shifts would be fired.

The nearest approach to the 24-hour job in the grading field was on an earth dam project in Illinois where the grading contractor worked two 10-hour shifts, one from 7:00 A.M. to 6:00 P.M. and the other from 7:00 P.M. to 6:00 A.M., allowing one hour for dinner in each shift. It happened during the Spring of 1933 that two labor crews were able to make only their 30 hours a week because the job was shut down by so much rain. Had the weather been good, the contractor planned to work six days a week with four labor crews.

Working Two Complete Labor Organizations

Most highway grading and paving contractors have used two complete crews, varying in the length of a day in some instances but in each case dividing the week in different ways. A contractor working in northwestern Pennsylvania used two organizations working 10 hours per day with No. 1 crew working Monday, Tuesday and Wednesday, and No. 2 crew, Thursday, Friday and Saturday. Two Kentucky contractors used a similar method and found that during the Spring of 1933



The Asphalt Crew on the Republic Asphalt Paving Co. Contract Near Johnsville, Ohio. This Work Was Done in Two 6-Hour Shifts a Day, Giving the Men the 30-Hour Week and Allowing for One Day a Week of Bad Weather or Breakdowns.

The Fine Grade Crew with the Scratchboard on the Quinn Construction Co. Concrete Paving Contract Near Bedford, Ind. This Contractor Organized His Hand Labor into Three Crews, Each of Which Worked Half-Days of 6½ Hours Each.

neither of the crews was able to work a full 30 hours because of wet weather.

A Dayton, Ohio, contractor works two 6-hour shifts between 7:00 A.M. and 7:00 P.M. running the job five days a week. This is an excellent idea as it permits the contractor to use Saturdays for making up any time lost during the week due to the weather, breakdowns or failure of the material supply. Along this same line a Kentucky contractor works two crews on two 8-hour and two 7-hour shifts a week. His working day is from 5:30 A.M. to 8:30 P.M. This contractor has allowed even a greater margin for possible breakdowns and failure in his material supply but found that he needed the extra time because of weather conditions.

MAXIMUM EMPLOYMENT BY USING THREE ORGANIZATIONS

A southeastern Pennsylvania contractor works three complete labor organizations up to 15 hours a day, dividing the work so that one group works Monday and Tuesday, the second group, Wednesday and Thursday, and the third group Friday and Saturday. During the hot weather early in June, it is doubtful whether these long hours could have been maintained but whenever men dropped off a job this year, there were always plenty of others on the sidelines ready to take up their tools.

One of the more complicated systems which must have required a well-trained battery of timekeepers was used by an Indiana contractor, who ran three crews, working two shifts a day of 6½ hours each and running the job seven days a week. Crew No. 1 worked Monday morning, Tuesday afternoon, Thursday morning and Friday afternoon; crew No. 2 worked Monday afternoon, Wednesday morning, Thursday afternoon and Saturday morning; and crew No. 3 worked Tuesday morning, Wednesday afternoon, Friday morning and Saturday afternoon. This arrangement still left each crew four hours short of its 30 hours of labor per week so each crew worked four hours on Sunday. The working day was from 5:30 A.M. to 6:30 P.M.

Another contractor with complicated ideas worked three gangs in two shifts a day, the first shift being from 5:00 A.M. to 12:30 P.M. and the second shift from 12:30 P.M. to 7:00 P.M. Crew No. 1 worked Monday, Tuesday, Wednesday and Saturday mornings; Crew No. 2 worked Wednesday, Thursday, Friday and Saturday afternoons; Crew No. 3 worked Monday and Tuesday mornings and Thursday and Friday afternoons. This also left each crew four hours short of its 30-hour week but they were not employed these extra four hours except in cases of emergency.

WORKING ALTERNATE WEEKS

One Indiana contractor worked two complete labor organizations with one group working six 10-hour days in one week and then alternating with the other organization on the second week. There is some doubt as to the legality of this method but it was approved by the State Highway Department and worked out most advantageously for the contractor. It also was a great help to the men in that particular district as they were able to put in one whole week earning money on the job and then spent the week off working their gardens or at such miscellaneous jobs as they could pick up.

Electrical Equipment of New Dredges

TWO mammoth pipeline type dredges have recently been placed in service by the U. S. Engineer Corps. They are self propelled and are designed specially for maintaining navigable depths in our inland waterways by keeping the channels free of alluvial deposits. Each dredge is 265 feet long overall and 48 feet wide. They were built in record time by the Dravo Contracting Co., Pittsburgh, Pa.

Power for operation of these dredges is furnished from oil-fired steam boilers. Electric drive is used for the main dredging plant as well as most of the auxiliaries. The majority of the electrical equipment was supplied by the Westinghouse Electric & Manufacturing Co.

The dredging power plant consists of a 1,200-kw, direct-current type geared turbine generator set comprising a 1,000-kw, 250-volt main generator and a 200-kw, 250-volt auxiliary unit. In addition, there are provided two 75-kw, steam turbine driven generators for supplying small auxiliaries as well as a 15-kw and a 2-kw unit for standby use.

One of the most interesting features of this installation is the special characteristic incorporated in the design of the 1,000-kw generator feeding the dredge pump motor which causes it inherently to deliver additional power when a plug attempts to form in the discharge line. This characteristic is made possible through the use of electric drive.

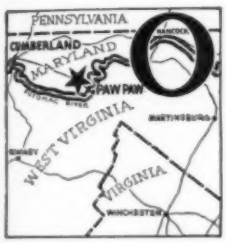
The dredge pump is of the centrifugal type and is suitable for pumping through a 20-inch diameter discharge pipe line. It is driven by a 1,200-hp motor which is fed from the above generator and designed to deliver its full horsepower rating at any speed between 200 and 250 rpm.

The 200-kw generator which feeds the motor driving the cutter or agitator is endowed with a characteristic similar to that of the main generator except that it is such as to limit the maximum torque or turning effort which can be applied to the cutter machinery. This is a noteworthy feature as it greatly reduces the shock or strain placed on the machinery when the cutter strikes an obstruction as it frequently does. This generator may also be used for supplying a 200-hp jet pump motor when this form of agitation is used.

The 225-hp cutter motor is geared to the cutter shaft and is mounted in an exposed position directly on the cutter ladder which is pivoted on the bow of the dredge. This motor is therefore water-proof and force-ventilated from a small motor driven fan mounted alongside. It is also equipped with special bearings to permit operation at an angle of 45 degrees with the horizontal. In addition to the above, a number of small direct current motors are utilized for driving the engine room pumps, capstans, winches, fans, etc.

Side-Dump Railway Cars *and* Crawler Wagons *in a* 100,000-Yard Cut

West Virginia Construction Co. Hauled Rock from 1,200-Foot Cut to Make One Mile of Fill

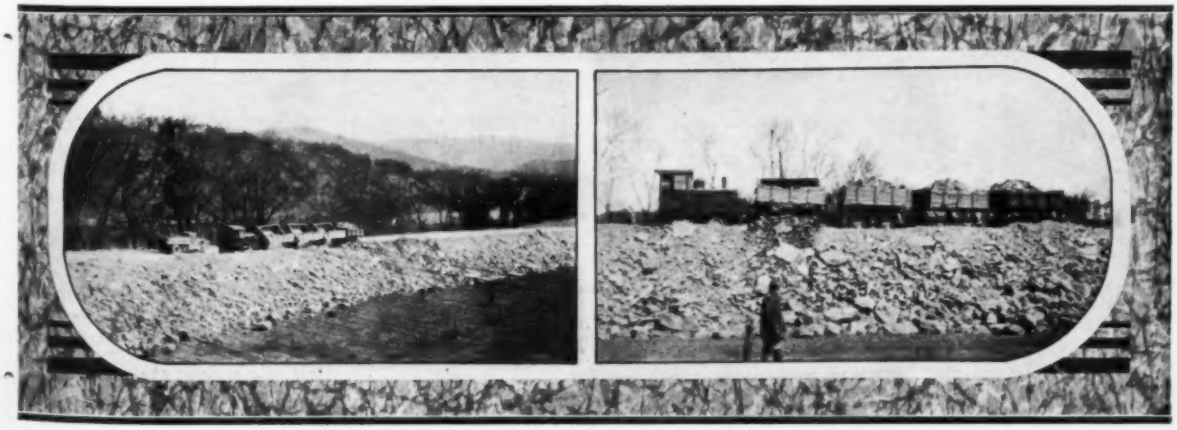


ON October 1, 1931, the West Virginia Construction Co. of Huntington, West Va., started work on 5.8 miles of grading through practically virgin country in the hills of southwestern Maryland. The contract called for moving 324,000 cubic yards of material from eighteen major cuts. The first cut about a mile from the Paw Paw, West Va., end of the job was supposed to require the removal of 89,251 cubic yards of rock, place measurement, but it ran well over 100,000 yards before the work was completed. This cut was 1,200 feet long and 90 feet deep at the highest point. This is reputed to be the deepest cut ever made on a highway project in the state of Maryland.

The work was pushed through the entire winter of 1931-32 and continued for ten hours a day, six days a week, until spring when the working day was lengthened to eleven hours. The grading project was completed on June 10, 1932, in the 150 working days allowed in the contract, which called for a $40 a day penalty for time beyond the contract limit.

Handling the Big Cut

The first operation in the big cut near Paw Paw, West Va., was to cut a notch 20 feet deep through the highest point. For this work a Lorain 75-A shovel powered with a Waukesha 87-horsepower gas engine was used, loading to a fleet of four to seven trucks equipped with dual pneumatic tires. The haul from the shovel averaged about 1,000 feet. Following this a standard-gage track was used laid into the cut with



Side-Dump Railway Cars Making the Mile-Long Rock Fill

a rather steep grade from the eastern or Paw Paw end and over which the trains of four 8-yard old Kilbourne & Jacobs side-dump cars were handled in a novel manner. On the flat grades a 12-ton Plymouth gasoline motor was used, hauling the cars a maximum of one mile from the cut to carry the fill over the flats.

In order to handle the empty and loaded trains readily on the steep grade from the end of the cut to the shovel, a novel single track cable tramway was devised with a passing switch. At the top, a 12 x 12-inch dead man 8 feet long was buried in concrete and to it an 18-inch homemade sheave pulley was attached. A cable run through this pulley was attached to the empty cars on the switch and to a tractor. The dinky, which

SCENES IN THE BIG CUT DURING THE EXCAVATION OF THE LAST LIFT

1. Loading one of the crawler wagons in the deepest section of the cut. 2. Coming out of the cut with a full load. This tractor was equipped with a bulldozer to spread the rock at the dump. 3. The start of a slide at the top of the Big Cut. 4. A tractor and crawler wagon about to make a hairpin turn to the left on the way to the dump. 5. The wagon drill which handled steel up to 21 feet long. 6. Wasting rock at one of the dumps. 7. A 50-foot culvert of 36-inch cast iron pipe with screw joints.

was at the head of the train, was then uncoupled, run on to the main line and coupled to the four loaded cars, and proceeded down grade to the fill. The Caterpillar Sixty then pulled the empties up to the shovel. On the return trip the loaded cars practically pulled the tractor uphill, the latter acting as a brake. The maximum grade on the track was about 15 per cent.

With this arrangement, the cut was taken down to within 20 feet of grade, when it became too narrow to operate the tractor and train so it was finished with trucks and crawler wagons. The cut was 85 feet deep in rock and shot on a 1 to 1 slope set 10 feet in at the top, thus making the final slope slightly steeper than the original slope specified. The rock would not hold on this slope; in fact, a slow slide developed on the south side of the cut near its highest point toward the end of May, 1932. As the rock was well broken at the foot of the slide there was no damage. At the center of the cut for about 150 feet, the shale changed to a blue boulder formation which disintegrated on exposure to the air.

The crawler wagon outfit used consisted of two 8-yard bottom-dump Euclid wagons, two Athey 8-yard wagons and one 10-yard Athey wagon with a special rebuilt bed. These same wagons were worked in the other heavy cuts, particularly that at Twig Hollow at about the center of the job.

Handling the Fill

The loaded trains were run over a temporary trestle over the old Baltimore & Ohio canal so that a new bridge could be built on the right-of-way. The fill was laid to a depth of 8 inches with all rock larger than 8 inches in diameter pushed to the side of the fill. The track was moved to the left or right as desired on top of the fill and the shattered rock bulldozed to position by three Caterpillar Sixties equipped with Euclid bulldozers. The fill was rolled with a 10-ton Huber gas roller. A Galion 10-foot blade grader hauled by a Caterpillar Sixty tractor was used for the final trimming of the grade. The contractor found that the largest production on the job occurred when he was using trucks for hauling because of the shorter waiting time at the shovel.

Drilling and Blasting

On the entire job there were three Ingersoll-Rand compressors, one 5 x 5, one 7 x 6 and one 8 x 10 with air hose running as far as 100 feet from the compressors. On the Twig Hollow cut, air pipe was used for maximum distances of 800 feet with 2-inch pipe for part of the distance reduced to 1-inch for the remainder. Three jack hammers were used, one with each compressor but most of the heavy drilling was done with a Gardner-Denver wagon drill which handled steel up to 21 feet long.

The holes were shot with Hercules 40 per cent dynamite and black powder. The rock was a shale which was characterized by the contractor as a "dead" rock in that it absorbed the shock of the explosions rather than shattering readily. The steel was hand sharpened by a blacksmith who had one helper.

Labor Organization

In the big cut the labor organization consisted of the shovel man, one oiler, three drillers, each with a helper, the blacksmith and helper, one powder man with three helpers, and from six to eight men on the dump, who also handled the track when the dinky was used. When the crawler wagons were used there were five tractor drivers, four of them on Caterpillar Sixties and one on the Allis-Chalmers Fifty. There were only two wagon winders. The work was in charge of the Superintendent who had one foreman with each shovel and one foreman on the dump. When the hauling was with railway equipment, between 90 and 100 carloads of 8 yards each were taken out per day. Throughout the work on the big cut the contractor averaged 12,000 yards of rock a month.

Equipment on Other Sections of the Job

In addition to the 100,000-yard cut, the details of which have been described, there were one 26,000-yard cut, one 24,000-yard cut, one 22,000-yard cut and one 11,000-yard cut. The excavating equipment for the entire job included three Thew-Lorain 75-A gas shovels and one Thew 76-B gas shovel and one Type B Bucyrus-Erie steam shovel. For each gasoline shovel a 500-gallon gas tank mounted on skids was kept close to the digging and was filled regularly by a local gasoline distributor. Thus at no time was it necessary for a shovel to shut down because of lack of an immediate gas supply. There was also a tool house and an explosives magazine each on skids.

Personnel

This large grading job was handled by the West Virginia Construction Co., Huntington, West Va., N. K. Sneed, President, with F. W. Sneed as Superintendent. For the Maryland State Roads Commission, F. M. Bork was Chief Inspector.

Tests of Riveted and Welded Steel Columns

As one of the Lehigh University publications, the Institute of Research, Lehigh University, Bethlehem, Pa., has reprinted a paper on tests of riveted and welded steel columns by Willis A. Slater, Research Professor, Engineering Materials and Director, Fritz Engineering Laboratory, who died October 5, 1931, and M. O. Fuller, Associate Professor of Civil Engineering, Lehigh University, Fritz Engineering Laboratory, which originally appeared in the *Proceedings* of the American Society of Civil Engineers, September, 1932. The tests reported in this paper were undertaken to secure a comparison of the behavior and strength of built-up steel columns fabricated by riveting with similar columns fabricated by welding. The program included nine columns of which two were riveted, and seven were welded. In four of the welded columns the welding was continuous throughout the length. In the other three welded columns intermittent or stitch welding was used.

The results of the tests showed that the largest slipping of plate was about 0.001-inch which may have been merely a difference in compressive deformation within the gage length. No weaknesses attributable to the slipping of plates developed. Stitch welding caused shortening of the metal at sections through the welds and elongation at the edges of the cover-plates. In general, the tests were favorable to welded columns and the average stress at maximum load was about 15 per cent greater than the strength computed by the Rankine formula.

Trench Bracing on a Steep Slope

Building the Brandywine Outfall Sewer

BRANDYWINE Creek of Revolutionary fame is the major source of water supply of the city of Wilmington, Del., and it is also the chief outlet for sewers from several large industrial plants above the city. E. I. du Pont de Nemours & Co., Inc., maintains an experimental laboratory on this stream and the wastes from that had caused trouble from time to time with the ortho-tolidine tests for free chlorine in the city water. Arrangements were made for the construction of 6,529 feet of outfall sewer as a joint project of the City and the du Pont Company. The sewer connects with an existing sewer whose outfall is located just below the intake of the city water supply and extends up the banks of the creek for over a mile. Eventually certain areas that cannot now be adequately brought into the city system will be connected with the new sewer which is built primarily for the disposal of trade wastes. The sewer is of vitrified pipe throughout because of the acid wastes which will be discharged into it. Also all of the manholes are built with an invert or bottom of vitrified brick as protection against acid erosion.

The lowest portion of the line is 22-inch pipe and then successively 24, 27 and 18-inch depending on the grade of the line. The depths of the trenches have varied from 2 feet to 18 feet and about 60 per cent of the trenches are in rock which was drilled with Schramm and I-R jack hammers supplied with air by Schramm, Ingersoll-Rand and Worthington portable compressors. All of the material was removed by hand as the territory through which the line runs is very rough and is mostly along the shore of the creek within a few feet of the flow line of the stream. In many cases the trench was carried below water level and where the grade runs through an existing dam the pipe is in the water.

Methods of Laying Pipe

As soon as a section of the trench was opened and mucked completely and the line for the pipe set above, the sewer pipe, which had been previously placed at storage points from which access to the trench was possible, was rolled to the side of the trench by two men. While in most cases of sewer construction it is possible to roll the pipe to the trench and then slide it down the side of the trench to the bottom, here the conditions were such that the pipe would almost surely be broken. The broken rock of the area in which the work was done and the steep bank along which the line runs made complete clearing of the trench impossible most of the time so that there were single jagged pieces of rock projecting into the trench and these had to be dodged. A short section of chain with a hook at the end was attached to a long length of rope and the chain and rope threaded through the pipe and the hook attached to the rope so that the pipe could be suspended in the trench. To protect the pipe from breakage as it was lowered into the trench two 2 x 8 planks were crossed and laid against the side of the trench from which the pipe was being lowered. These acted as a bumper and reduced the breakage to a very small figure.

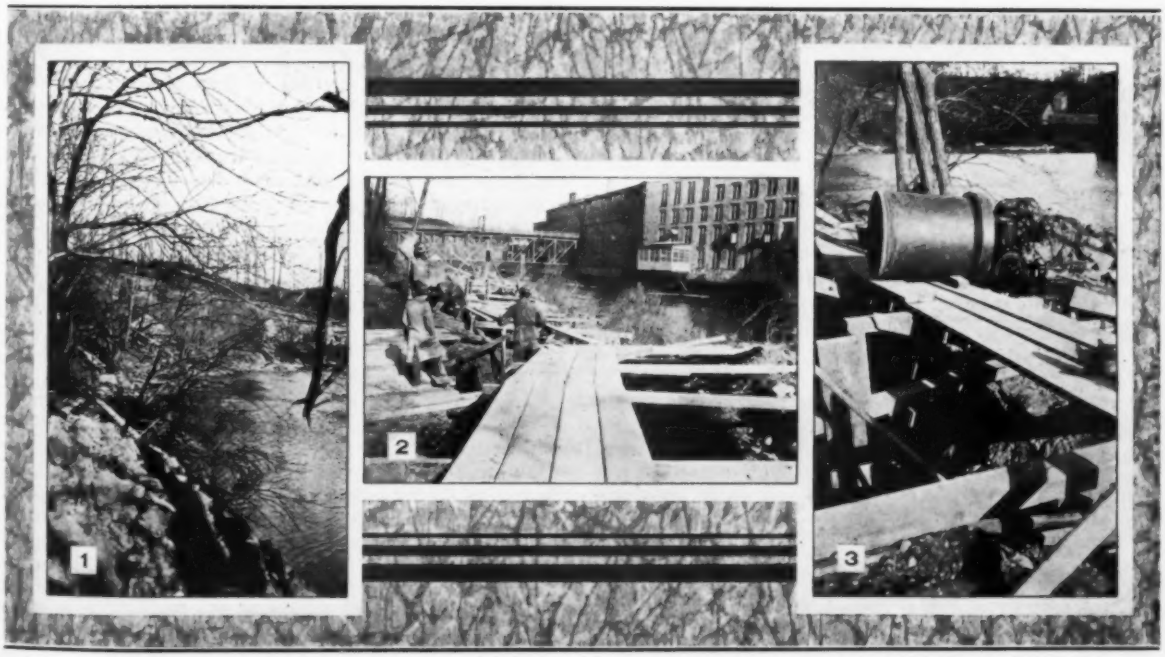
Short sections of trench were handled at a time and dammed off for laying the pipe because of the large

Unusual Conditions Faced, with Alternate High and Low Banks, High Water Trench in Narrow Dike and Through Old Rubbish Dump

amount of water that was continuously flowing in. Three Novo pumps were used along the work to keep the water down while actual laying was in progress and until the joints were poured and the end of the line plugged. The joints were made up with asbestos yarn well rammed against the bell and a joint of Pure Seal asphalt furnished by the Pure Asphalt Products Co. of Newmarket, N. J. The backfill was done by hand as no power equipment could get into the tight places alongside the trench. Where the cover was light on shallow trench and the line was close to the flow line of the creek the entire pipe was surrounded with 6 inches of concrete to protect it from floating débris at times of high water and ice jams which often occur in the winter time. The creek is flashy and carries a large amount of timber and other floating material washed from the banks. A 1:2:4 mix of concrete was used.

Unloading the Pipe

The left bank of the creek is slightly more open than the right bank, at least it is not as closely built up with factories, and it has a freight spur for about one-half the length of the line, serving a quarry and some of the industrial plants. The box cars of vitrified pipe were brought in on the spur track and unloaded down the steep bank to a temporary road close to the sewer trench. Before unloading started, both doors of the car were opened and the car spotted where there was a good sized tree above the car to which the tackle could be attached and a clear path cut down to the temporary road. Then a runway which was used over and over was laid down the slope. It consisted of oiled 4 x 6's with one side higher than the other so that with the bell laid on that side, as the pipe was let down the runway, the bell would hug the higher side like the flange of a railway wheel. With this rigging a carload of pipe could be unloaded with remarkable speed. The



ROUGH TERRITORY MADE UNUSUAL METHODS OF SEWER CONSTRUCTION NECESSARY

1. A typical section of the shore line of Brandywine Creek. 2. Constructing the runway for concreting. Note the various methods of supporting the planks. 3. A section of vitrified sewer pipe ready to be lowered into the trench. In the background, one of the pumps used to keep the trench dry.

pipe was furnished by the Robinson Clay Products Co. of Baltimore, Md.

METHOD OF CONCRETING

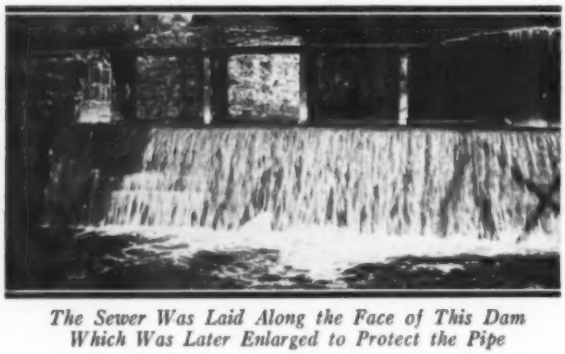
When a section of pipe was to be concreted a Jaeger 1-bag mixer was towed along the temporary road by a truck and spotted as close to the center of operations as possible where there was space for the truck to deliver a limited stockpile of aggregates. Then a runway was constructed from the front of the mixer along the trench so that buggies could be wheeled readily and the concrete dumped directly onto the pipe where it was spread by shovel men. The runway was usually built in these sections well ahead of concreting so that it could be used for handling the pipe as well.

The runway was built up as simply as possible, using the spoil on one side and rocks or short posts on the other to support the 4 x 6 stringers on which the 2 x 8 planking was laid running longitudinally. A few diagonals nailed to stakes served to brace the temporary structure.

There were many short tunnels along the line made necessary by the requirement that all trees be preserved if possible. The lower reaches of the Brandywine are a park area, a portion of the land through which the line passes is park at the present time, and it is hoped eventually to run the park further upstream; hence the desire to save the trees. Many of the tunnels were from 5 to 14 feet long and the longest was 30 feet long. These were not easy to handle because of the broken character of the rock through which they ran. Along the river side of the trenches the bank was much lower than on the far side which greatly complicated the shoring. The shoring was chiefly 3 x 12 and 6 x 6 timber. In one section the area had been used for an industrial dump for a great many years and the material would not stand well when the trench was excavated. In another section where the rock was badly shattered it was necessary to shoot carefully and then pin and feather the larger pieces and pull them out without block-holing.

OTHER FEATURES

At the start of the work near the paper mill intake, the sewer is located in a narrow dike for 680 feet where the section of the rock dike is only 10 to 20 feet and the trench ran below water level in the intake canal. Through this dike all rock had to be broken by wedging or feathering. Blasting was not permitted as it was feared the dike could not stand it. At another point in the lower section of the line the sewer was laid along the face of a small dam and then the dam was enlarged to include the sewer pipe, thus protecting it from damage.



The Sewer Was Laid Along the Face of This Dam Which Was Later Enlarged to Protect the Pipe

At one point it was necessary to carry the sewer over a mill race to maintain the grade without using an inverted siphon. The line came along behind a stone wall built of stones 3 x 3 x 4 feet set in concrete through which it was necessary to cut a hole for the sewer and then carry it over the mill race with a bridge and through a similar wall on the other side. The bridge was made up of 5/16-inch plates on the side and ¼-inch on the bottom with 6 x 4 x ½-inch angles longitudinally top and bottom and across the top every 10 feet for stiffeners. The pipe was laid inside and encased with concrete. The bridge was shipped from the shop in three sections and assembled at the top of the steep bank above the site and eased down the slope with a truck crane and set in place.

PERSONNEL

The Brandywine Creek outfall sewer was a joint project of the City of Wilmington, Del., and E. I. du Pont de Nemours & Co., Inc., who shared the cost. The design and engineering supervision of construction was handled by the du Pont Co. with L. C. Parker as Resident Engineer. The contractor for the work was George & Lynch of Dover, Del., with John Lowe as Superintendent. The rock excavation from Sta. 17+50 to the end, Sta. 65+29 was done under subcontract by Vincenzo DiFrancesco of Llanerch, Pa., with Joseph DiFrancesco as Superintendent.

Low Cost Roads and Bridges

FEW subjects pertaining to roads have received more attention by engineers and officials in recent years than that of low cost roads. The use of equipment and the mileage of secondary and low-cost roads have increased greatly in the past five years and indications are that they will continue to increase. A new book "Low Cost Roads and Bridges," by Victor J. Brown and Carlton N. Conner has recently been published and discusses the best practice in the design, construction and maintenance of low-cost roads. Various phases of the subject are covered, including highway location and economics, grade line design, width, visibility, traffic analysis, and other engineering subjects as well as methods of construction and a chapter on low-cost bridges and culverts. This book is published by the Gillette Publishing Co., Chicago, Ill.

No Peddling Prices Here

WE recently heard of a large general contractor who sent out a letter to subcontractors asking them to submit figures on a job which he was figuring. This is what the letter said:

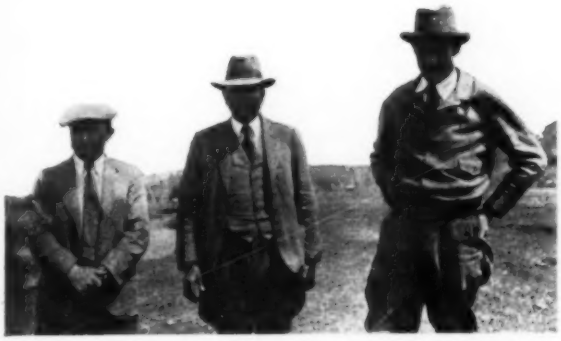
"We will use the lowest legitimate sub-bids entrusted to us in making up our estimate. We will not expose or discount any figures given us. We will also agree to award subcontracts on the basis of the figures used in our setup, should we be the successful contractor. We do not make it a practice to burden our subcontractors with back charges for which they are not responsible. We are financially sound. We take all discounts and pay our subcontractors when their bills become due."

The owner of that job will be fortunate if this contractor is awarded the work. A man who treats subs in this manner can be safely trusted to live up to his contract.

From *The Construction Adviser*, Jefferson City, Mo.

Pit-Run Gravel Road Construction *in* Virginia

Simplicity of Equipment and Importance of Hauling Are Features



D. S. Blount, A. A. Hayman and R. Worthington, Inspector

VIRGINIA is taking a great step forward in the construction of its primary roads and is producing highways with gravel bases that are a credit to the Commonwealth. The gravel bases serve as the foundation for bituminous treatment by the State to preserve the road structure. Several roads of this type were under contract during the 1932 construction season. One, running south from Luray, will serve as an excellent example. The road was 5.426 miles long with a 20-foot gravel surface, 30 feet wide, including the shoulders, on fills and 32 feet in cuts.

Blount & Hayman of Broadnax, Va., took over the work from a subcontractor on April 12, 1932, and immediately made speed with an efficient organization.

Grading

The grading of the project required the moving of 56,000 cubic yards of excavation which was handled with a 1¼-yard Speedcrane shovel with a 100-horsepower Hercules engine. A fleet of six heavy trucks with dual pneumatic rear wheels and with hydraulic dump hoists hauled the excavated material to the fills. The average hauls for this work were from 500 to 800 feet.

Gravel Excavation

There were 18,000 cubic yards of pit-run gravel called for on this project and it was all secured with a good amount of top soil binder from the bed and banks of a nearby stream known as Hawksbill Creek. The Speedcrane which was used for the road excavation was run into the stream about to the level of the top of the crawlers and dug upstream, leaving a dike behind it and on the stream side so that it was not working in running water. This dike also served as a safeguard against a slight rise in the level of the stream. The shovel loaded from a 5-foot face in the stream.

A fleet of fifteen Chevrolet and Ford trucks individually owned and hired by the hour was used for hauling the gravel. At first the trucks were loaded with two dippers of gravel but that resulted in so many broken springs and the drivers ran the trucks so slowly to prevent damage that the load was reduced to one dipperful with a resulting increase in daily production. To place 1,000 cubic yards of gravel on the road in compacted form required digging and hauling from 1,400 to 1,500 cubic yards from the stream. This was the average daily production with a slight variation either way.

The haul was over meadow-land and with one-way traffic to speed up the production and the pit was lo-

Digging the Gravel From the Banks of Hawksbill Creek

By Dumping in Lanes, Two Trucks Could Be Handled at One Time and Spreading Was Minimized

cated ¼-mile dead haul from the road. The maximum haul from the shovel to the delivery point on the road was 2 miles.

PREPARATION OF SUBGRADE AND PLACING GRAVEL

After the excavation had been completed on the road the entire top surface was scarified with a Killefer scarifier and bladed to final subgrade elevation with a No. 12 Adams grader. The scarifier was pulled with a Caterpillar Thirty and a Sixty was used for the grader. About ten men were used as hand labor on the shoulders during the subgrading.

The gravel was dumped from the tail-gates of the trucks, spreading as much as possible to approximate the 10-inch depth of gravel required. A hand labor crew of six men with stone rakes and an Adams No. 3 maintainer smoothed off the gravel and picked out the large stones that were brought up by the maintainer. A Euclid sheepsfoot roller was used for compacting both the subgrade and the gravel where necessary. The gravel was of a particularly good grade with the loam that was mixed with it in the excavation from the stream bed so that it compacted very well under traffic. Even the light traffic that used the road during construction, and the road was not closed at any time, produced a very fair traffic-bound top.

PERSONNEL

Because the subcontractor who had the work before it was taken over by Blount & Hayman was running considerably behind schedule, they worked a 12-hour day and made very good progress, laying an average of 1,400 feet of 10-inch compacted gravel 20 feet wide per day. Both partners of the organization were on the job, A. A. Hayman at the gravel pit and D. S. Blount on the road. R. Worthington was Inspector for the Virginia State Highway Commission. The contractor is well known for bridge work in the South.

Highway Maintenance by Contract

IN an article, "The Efficient Spending of the Tax Dollar," Richard Hopkins, Past President, New York State Highway Chapter, Associated General Contractors of America, published in *The Low Bidder,* official organ of that chapter, points out the inherent faults of the town highway system in New York State. He shows first there is poor engineering, and then that there is a large amount of machinery that is used for a small part of the working year. While practically all of the county superintendents are high class engineers, only a few of the township superintendents are engineers at all and these few are located in the wealthy towns where they are called on to do high class construction comparable to the state highways. On the other hand the county has good engineering facilities and in most cases good construction. Mr. Hopkins continues:

"Quite a number of counties do the bulk of their work by contract; a much larger number do all of their work by day labor. Some counties do part by contract and part by day labor. In these latter counties it is significant that when the job is difficult and rigid specifications are to be followed, the work is nearly always done by contract. It is further significant that a number of county superintendents, who previously let no work by contract, have been doing a large percentage of contract work the past two years. The reasons are not hard to find. First, they have found the taxpayers critical of their workmanship and also of their costs. Second, they have found that contractors' costs have decreased by a much larger percentage than their own costs have decreased. They have found that the political and personal pressure put on them the last two years to find jobs for incompetent workers is much stronger than ever before. They have found that the average taxpayer of a few years ago, who used to smile when he saw a gang of day labor men leaning on their shovels or resting serenely in the soothing shade of the spreading chestnut tree, has suddenly become the average taxpayer who is sharp in his criticism of the public official who allows any waste of money in his work."

Then there is the question of maintenance by the State Highway Department. The yard-stick by which to determine what maintenance work to let by contract is "can approximate quantities be determined when the work is advertised for bids." Frequently highway engineers make the statement that they would let more maintenance work by contract if they were able to figure beforehand on approximate quantities. Suppose the state advertises a maintenance contract involving 50 miles in one portion of a county with part of the mileage in concrete, part in macadam and part in gravel and assume that the contract is to run for one year. Here are a few of the typical items that can be definitely estimated and that would be in the contract; miles of crack pouring, cubic yards or square yards of concrete pavement, gallons of bituminous material, tons of bituminous mixed top, cubic yards of subbase, cubic yards of crushed stone, cubic yards of gravel, linear feet of drain tile, cubic yards of excavation in slides or in alignment changes, miles of cutting grass and trimming brush, miles of scraping shoulders, miles of cleaning ditches, cubic yards of borrow excavation, cubic yards of concrete in structures and lump sum protection of traffic.

A fair question asked by Mr. Hopkins is, "What proportion of the work now done by the state maintenance forces could profitably be let by contract?" His estimate is 60 to 70 per cent. Some highway engineers raised the question as to whether contractors would care to bid on small jobs. The answer is, "Yes." County highway lettings for the last 20 years have shown plenty of competition. Some contracts have run as low as $1,200; some have been in excess of $250,000. To show that contractors will bid on low cost roads, one county in Michigan let about 60 miles of roads in 1931 at an average cost of $2,000 per mile.

Mr. Hopkins concludes by an interesting series of questions, "Does the State of New York and the United States Government build their public buildings by day labor? Why does the U. S. Bureau of Public Roads insist that Federal Aid money be spent by contract? Why is it that nearly every city and village charter contains a provision that any work in excess of $500 shall be let by competitive bidding? Years and years of experience have taught the lesson that rigid specifications, high quality of workmanship and low costs go hand in hand with competitive bidding. These years have taught that business executives welding together an organization of eager and able craftsmen have built best and built cheapest."

Protecting Profit *in* Bad Weather

Part II

By
J. L. Harrison
Senior Highway Engineer
U. S. Bureau of Public Roads

DISCUSSION of the direct expense caused by bad weather as an item in the "expense account" appeared in the first part of this article in our June issue. The relation of weather to profit would be serious enough if the matter could be dropped here. Unfortunately it cannot, for while the direct expense which must be met on account of bad weather is occasionally of such magnitude as to wipe out profit completely, the effect of bad weather on production may be even more disastrous. This depends somewhat on the type of work under construction, but taking highway work generally, the loss of production appears to be the more important of these two phases of the problem of weather losses.

On the production side of every construction operation the contractor always faces the elementary fact that the unit cost equals the cost of labor plus equipment values plus materials during any unit of time, divided by the production during the same unit of time. As was pointed out in the discussion of gross profit, this will apply for the job as a whole, that is, for the total time during which production was actually under way, or for any shorter period, as a week or a day or an hour. Generally, it is advisable to use the working day as the time unit, and when a job is studied from this standpoint it will usually be found that following wet weather, production falls off rather sharply.

It is not at all necessary to go into the details here. The point is that, as a matter of common knowledge, the period immediately following a protracted storm is one in which the transportation units function with difficulty, light loading or reduced speeds or both being the rule, and that other difficulties are also encountered. As a result production is reduced, this condition applying to many types of construction work.

But, reverting again to the paving outfit, the assumed cost of the labor used in securing production is based on an output of 2,000 square yards a day from which it is apparent that the unit cost of labor is $0.14. If production falls to 1,400 square yards, the unit cost of labor is $0.20 and if it falls to 1,000 square yards a day, the unit cost of labor is $0.28.

It is, of course, apparent that no condition prevails during wet weather which will permit of any reduction of the cost of operation. On the contrary, conditions are such that if there is any change in the cost of operation it is an increase. However, as jobs are handled, the daily cost of operation is pretty constant for the machines and the methods used in operating them dictate the number of men employed, so it seldom is the practice to change either to any considerable extent in order to meet adverse weather conditions. Therefore, the assumption that the daily cost of the labor used remains constant is reasonable. Moreover, the accuracy of this assumption has been verified on a large number of jobs.

The Cash Loss of Decreased Production

But the assumed net profit on this work is only 6 cents a square yard. Therefore, whenever production falls as little as 600 square yards a day, practically all net profit is lost. Indeed the actual situation is somewhat worse than this for both the cost of operating the equipment and the cost of equipment depreciation are, in fact, affected just as the cost of labor is affected. Therefore, a more accurate appraisal of the situation would be had if the operation and depreciation charges, $196 a day, were added to the labor charge in this case making the variable charge $480 in which case the ordinary unit charge would be 480 divided by

2,000 or $0.24. This variable cost would then increase to $0.30 per square yard if production dropped to 1,600 square yards a day, that is if production dropped as little as 400 square yards. If production is cut in half, the unit variable cost increases to $0.48 in which case not only is all net profit lost but nothing is earned for gross profit.

To put this matter in a little different way, every time a day's work is done at the rate of 1,000 square yards, the net profit on 4,000 square yards all of which, except the first 1,000 square yards, must be placed at the average rate of 2,000 square yards a day, is lost. This is the profit on 1½ days work at the normal rate of production.

These two types of loss due to bad weather, direct expense incurred in spite of the fact that no work is being done and reduced production caused by the weather, are likely to occur on any type of out-of-doors work but they are particularly aggravated wherever hauling is a large element in the expense of operation. Therefore, they are perhaps a little more pronounced in highway work than in most of the other lines of activity.

Loss of Materials

The loss of materials presents a third source of loss chargeable to bad weather. Grades are damaged, occasionally washed entirely away. This may mean that more material must be moved than is paid for. More often, however, it merely means that the expense of cleaning up will be increased. Stockpile losses are quite generally increased by wet weather and occasionally other materials are lost or rendered unfit for use. Losses in this field attract attention and so are likely to be considered larger than they really are. Their importance should not be minimized, but even after giving their importance full weight they seldom are as destructive of profit as the direct expense occasioned by carrying straight-time men and the loss of production which so generally attends bad weather.

Avoiding Weather Losses

To outline the nature of weather losses would hardly be of advantage unless some light could be thrown on the matter of their avoidance. For this purpose grading outfits offer a good illustration. Where grading is being done, the hauling may be done by means of horses or mules or by means of trucks or tractors. The cost of moving material during good weather may not differ much as between the horse-drawn equipment and the power equipment. But the power equipment eats nothing and requires little care while it is idle, so the heavy cost of keeping and feeding idle horses during periods of bad weather is at once abolished if power equipment is installed. The men who drive motorized equipment draw a somewhat higher wage than usually is paid teamsters, but, as a general thing, they handle units enough larger to justify this. More important, they do not, as a matter of general practice, expect to be fed during bad weather. The result is to reduce the expense involved in remaining idle to the salaries of the one or two men who are so important in successful operation that their demand for full-time pay must be met, or who are actually needed without regard to the weather. A fully motorized outfit should then have an idle time expense of from $15 to $25 a day, as compared to an idle time expense that may run from $75 to $90 a day where a horse or a mule outfit is used.

The indirect saving during bad weather is no less than the direct saving if motorized outfits are correctly handled, though it must be admitted that this is not always done, for many contractors attempt to handle motorized outfits about as they have been accustomed to handle horse and mule outfits. With a fairly large horse outfit, if the cost of working is $125 a day and the cost of lying idle is $75 a day, it costs only $50 a day more to work than it does to lie idle. But, this being the case, even though the weather is bad and it is known that production will be low, it nevertheless is desirable to work whenever there is reasonable prospect that the outfit can move dirt worth more than $50 for whatever the outfit earns above this sum will reduce the dead cost of remaining idle. If the price received for excavation is $.20 a cubic yard, this means that whenever more than 250 cubic yards can probably be moved, something will be earned to reduce the $75.00 charge that would be generated by doing nothing at all, so the outfit ought to be worked. The general result is that horse-drawn equipment is worked just as much as is physically possible regardless of the weather and, in general, this is correct.

On the other hand, assuming for the moment that the motorized outfit would have the same operating cost as the horse-drawn outfit, but that for the reasons given above the idle time charge is only $15, the difference between the idle time expense and the cost of working is $110 a day. The assumption that the daily cost of operating the motorized outfit will be the same as the daily cost of operating the horse-drawn outfit may be questioned. Obviously, if the motorized outfit is well selected the labor cost will be lower than where horses are used, while depreciation and operation charges will be higher. Whether the total daily operating cost will be a little less, about the same or a little higher will depend on the equipment selected. This, however, is not the important consideration here. Rather, the point is that because of the much larger difference there is between the cost of working and the cost of remaining idle, a much larger production must be obtainable in order to justify working at all! In other words, it must be possible to secure pretty nearly a full output before it pays to work.

Summary

What has been said of grading work applies to construction work generally. The path toward low bad weather losses involves four things: first, the selection of thoroughly appropriate modern equipment that generates only a modest idle time expense; second, the employment of as few men as possible on a straight-time basis; third, the avoidance of the high cost of low production by refusing to work when conditions are such that a reasonable production is impossible; and, fourth, the avoidance of expenditures on subsidiary operations when the job as a whole is closed down. It may be of interest if the fact is added that, with many types of modern equipment, there is much greater danger of losing money because of working too soon after a heavy rain or other adverse weather conditions

(*Continued on page 32*)

A Four-Lane Relief Highway

S. J. Groves & Sons Built 5.69-Mile Pavement from New Jersey State Line North to Nyack-Suffern Turnpike with Smooth Running Organization

CONSTANTLY increasing automobile traffic on the west shore of the Hudson River since the opening of the George Washington Bridge between 178th Street, New York City and New Jersey, has caused the State of New Jersey to widen U. S. Route 9W and New York State has widened its connecting link from the New Jersey State line north to the Sparkill Viaduct. From that point for a distance of about 10 miles numerous curves and the steep slopes of the Palisades make the widening of 9W an expensive proposition. Because of this the New York State Department of Public Works has chosen to construct a new highway paralleling 9W and about ½ to ¾-mile west of the main thoroughfare. At present the highway does not connect with anything at either end but New Jersey has already completed plans for its connecting link to the south and several alternate connections have been planned to connect the north end of this new project with 9W in the vicinity of Haverstraw, N. Y., where the State Highway was built as a three-lane pavement. It is also expected to connect with 9W at the Sparkill Viaduct by a spur.

Culvert Construction

Most of the culverts on this work were poured with ready-mixed concrete. Where the ground was not sufficiently firm to permit the heavy Blaw-Knox truck mixers to run close to the forms, a short section of industrial track was laid from the roadway to the forms and the concrete delivered to an Atlas industrial dump car and run out onto the forms and emptied direct into them. There were two Rex and one Blaw-Knox truck mixers used which were supplied by the Tidewater Stone & Supply Co. of Hackensack, N. J. One of the larger culverts at Orangeburg, N. Y., required 98 yards of concrete in the walls alone. This was poured in seven hours, using a Ransome 27-E paver parked on solid ground and the Atlas industrial car to run the concrete on the forms.

The Old Tappan Road Overpass

Because of the prospective heavy traffic which will use this new Greenbush Road it was decided to carry it over the Old Tappan Road which connects Sparkill and Tappan, N. Y. A substantial structure of reinforced concrete construction was built with an I-beam deck encased in concrete. The forms for the concrete were lined with a composition veneer wood which proved successful in eliminating the usual form marks. The material seemed to absorb an unusual amount of

water, however, and left sand marks on the face of the concrete. This necessitated the usual hand rubbing which it was hoped would be eliminated through the use of the form lining. Later work made use of a tempered material of the same manufacturer which did not absorb the water and produced much better results.

In backfilling the abutments, a fleet of five Caterpillar Sixty tractors hauling Athey Truss Wheel trailers with three-way dump bodies hauled the sandy material from a pit where it was loaded with a Thew-Lorain 75-B shovel. The foreman handled the heavy traffic of these units and the spreading of the material with a Caterpillar Sixty and LaPlant-Choate bulldozer with remarkable dexterity and the operators themselves manipulated the units as skillfully as a New York City taxi driver dodges trucks and cars. When a tractor lost traction in the soft fill, the bulldozer pulled in behind and gave it a boost which sent the outfit into service in a moment's time.

In order to provide proper drainage at the abutment walls, about 1 foot of coarse stone was spread against the walls. This was handled from a small stockpile alongside the work by a Link-Belt crane and clamshell and dropped against the wall behind a bulkhead with the help of three men, two of whom held a light 3 x 6-foot guide board to form a chute for the stone, directing it behind the form. The stone was trimmed with stone forks and the same men shoveled the dirt against the form after it had been pushed to approximate location by the bulldozer. The fill was rolled in 1-foot layers by a 10-ton Buffalo-Springfield gas roller.

QUANTITIES AND PRICES

Item	Quantity	Unit Price
Clearing and grubbing	Lump sum	$4,000.00
Unclassified excavation	337,800 cubic yards	.35
Trench and culvert excavation	2,500 cubic yards	1.00
Wet excavation	1,450 cubic yards	2.00
12-inch sewer pipe	200 linear feet	.90
4-inch pipe underdrain	570 linear feet	.30
6-inch pipe underdrain	2,500 linear feet	.35
Trimming shoulders	29,300 linear feet of road	.05
Preparing fine grade	132,100 square yards	.05
Timber and lumber	4,000 feet B. M.	70.00
18-inch cast iron pipe	710 linear feet	3.00
24-inch cast iron pipe	700 linear feet	4.50
18-inch reinforced concrete pipe	250 linear feet	2.00
24-inch reinforced concrete pipe	60 linear feet	3.00
Portland cement	58,814 barrels	1.50
Concrete for structures	850 cubic yards	14.00
Concrete for parapets	54 cubic yards	25.00
First class concrete	1,128 cubic yards	12.00
Second class concrete	2,135 cubic yards	10.00
Metal reinforcing for concrete pavement	132,100 sq. yards of pavement	.20
Steel fabric reinforcing for conc. pavement	470 sq. yards of pavement	.35
Bar reinforcing for concrete pavement	17,000 pounds	.06
Metal reinforcing for culverts	9,564 square feet	.10
Bar reinforcing for structures	80,677 pounds	.04
Structural steel	98,700 pounds	.04
Miscellaneous iron and steel	2,350 pounds	.10
Cable guide railing	28,000 linear feet	.55
Concrete guide posts	100	2.00
Metal railing	98 linear feet	4.00
Foundation course, run-of-bank gravel	6,020 cubic yards	.50
Cement concrete pavement	29,415 cubic yards	4.00
Bituminous material waterproofing	500 gallons	.50
Maintaining traffic	12,500 linear feet	.05
Protection of traffic	Lump sum	250.00
Protection of traffic	Lump sum	100.00
Concrete piles cast in place	4,200 linear feet	1.85
Screened gravel, loose measure	410 cubic yards	2.00
Broken stone, No. 2 size	50 cubic yards	2.00
Broken stone, No. 3 size	25 cubic yards	2.00
Broken stone, No. 4 size	300 cubic yards	2.00
Concrete curbing Type B special	3,300 linear feet	1.00
Concrete gutter	500 square yards	1.70
Concrete right-of-way markers	230	2.00
Concrete ornaments	4	25.00
Trimming roadway	4,950 linear feet of road	.10
TOTAL BID		$468,285.98

FINE GRADE LIKE A BILLIARD TABLE

The rough grade and drainage system, including the filling of several large muck holes with stable material after the humus and peat had been excavated, was completed late in May, 1932, and on June 1 the fine grade and concreting crews started producing the long narrow lanes for pouring the concrete. The fine grade was prepared with a Warco one-man grader and a Good Roads 5-ton roller, with an Irish Fordson motor, which the superintendent said was true to its race. Following the preparation of the grade for the full 40-foot width of the pavement, the form crew stepped in and set the 8-inch Blaw-Knox forms made with an 8-inch base to increase their bearing and minimize the chance of settlement. Two men set the line for the forms ahead and four men set the forms under the direction of the foreman. With one set of forms in place or with one slab poured, the second set of forms was spaced accurately with a 2 x 4 notched at the ends and with short sections of angle iron set in to prevent wear. The fine grade between the forms was handled by three hand laborers and one roller man, aided by a home-made subgrader which proved very effective.

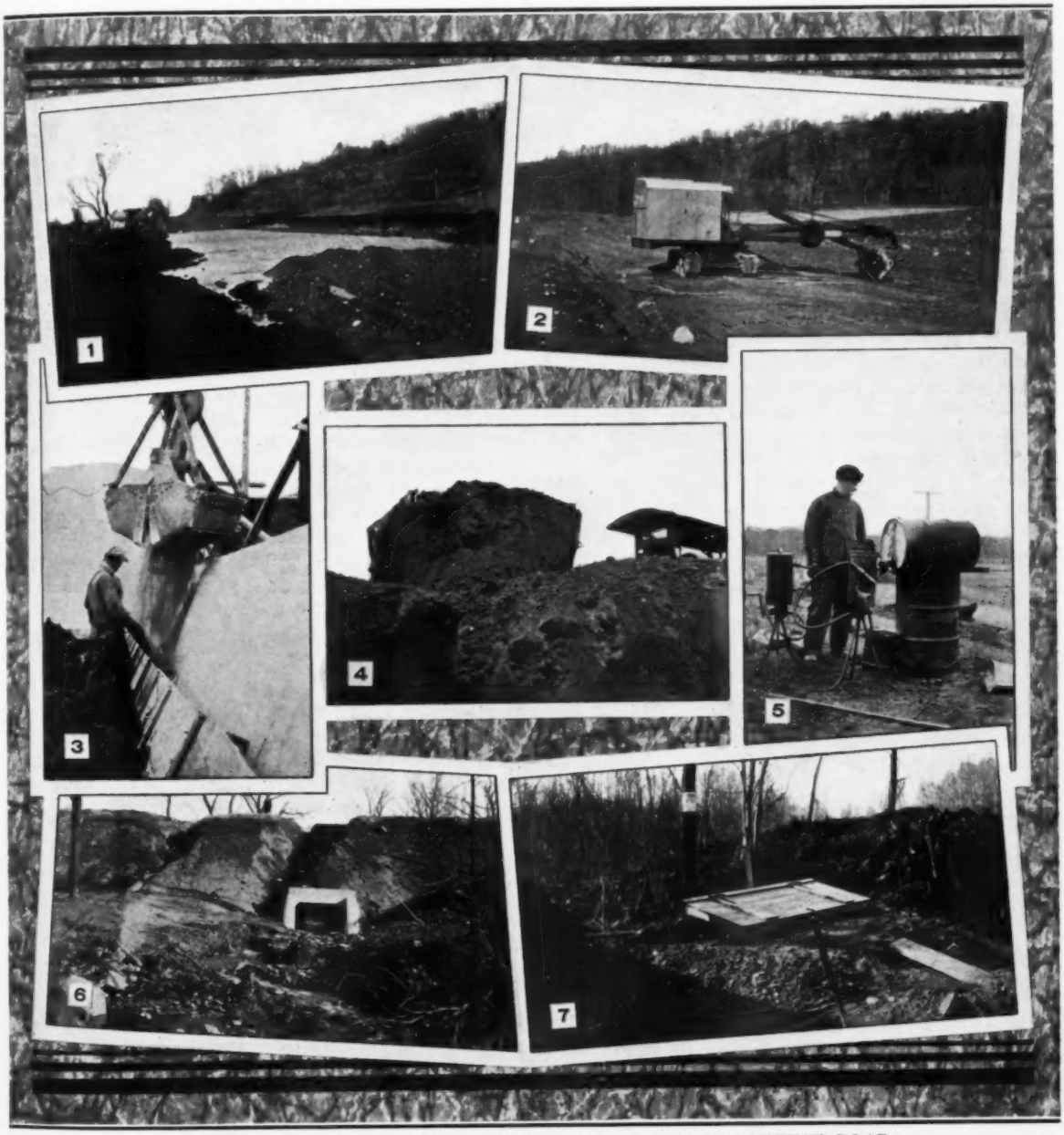
The subgrader was built with four 6-inch wheels with 1½-inch inside flanges and with a hardened steel blade carried on an I-beam cross-member with the lower flange turned off. A lever and toggle device made it possible to raise and lower the front wheels as a means of lifting or lowering the blade. The hand laborers filled low spots ahead of the subgrader, taking out any large stones. Then the machine was pulled forward by the roller with the three men riding it. This device greatly speeded up the preparation of the fine grade even in the heavy clay section. The next operation was the lining up of the forms which was done by two men under the watchful eye of the inspector. Three men with a 250-pound hand lawn roller gave the final finish to the grade. They used a hand subgrader similar to the one described above which was built before the heavier machine. The web of the I-beam carrying the blade was slotted so that the blade could be adjusted according to the type of soil in which the men were working.

Back of the fine grade crew one man oiled the forms and set the premoulded expansion joint every 78 feet 6 inches. The expansion joint was set with an equal leg cap on top, three pins on the side away from the concrete and two on the concrete side. Through the 10-foot expansion joint five ½-inch dowels were run with wire chairs spot-welded on the side away from the concrete and tin tubes, flattened at the end and turned down to support the dowels on the concrete side. Thus the dowels were supported on both sides so that when concrete was spread across the joint there was no chance of the dowels being tipped from their specified horizontal position. As an additional precaution an angle iron and strap iron frame which fitted across the forms and with legs notched at the ends to fit over the tops of the dowels was placed on top of each expansion joint when poured. This prevented the joint from rising and also prevented any turning of the dowel from a position parallel to the forms. The oiler was also responsible for sweeping the hay back from the edge of an adjacent strip of concrete and cleaning the edge of the concrete so that the flat wheel of the finishing machine would run smoothly along the edge.

CONCRETING

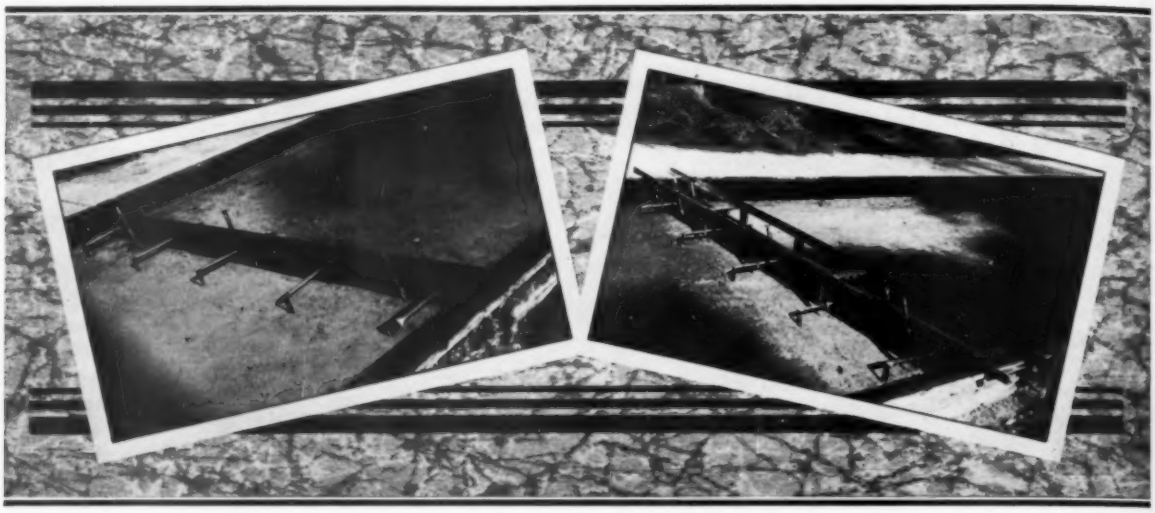
The batches were delivered by 4-batch trucks with dual pneumatic rear wheels and were dumped into the skip of the new Ransome 27-E paver by one man. In addition to the operator this job carried an oiler on the paver. A 24-foot boom on the paver made it possible for it to operate on an accepted strip of concrete and reach over a green strip to pour the 10-foot strip beyond. Two by 12-inch planks were always laid on the concrete to prevent any possible marring of the surface by the crawlers of the paver.

As the paver operator spread the concrete with the bucket, three pit men finished the operation, pushing it into place and two spade men using regulation concrete spades worked it along the forms to prevent honeycomb. One of these men was also responsible for sprinkling the grade ahead of pouring. Truscon 6 x 6-inch spot-welded mats 15 feet long were used for reinforcing. The concrete was poured and struck off 2



PREPARATION OF THE ROUGH GRADE ON THE NEW GREENBUSH ROAD

1. One of the large muck holes, showing the black muck excavated and dumped at the left, and the gravel fill progressing from the right. 2. This 75-B shovel was used effectively as a barrier on Sundays and for handling borrow the remainder of the week. 3. Dribbling stone against the back of a retaining wall to furnish drainage prior to backfilling. 4. One of the 3-way dump crawler wagons dumping a load at the edge of the approach fill at the Old Tappan Road overpass. 5. The lubricating outfit for the tractors. The improvised heater made from an oil drum was particularly useful in the early spring. 6. One of the box culverts beneath a high fill which was badly eroded during heavy rains in February, 1932. 7. Explosives storage on the edge of a swamp.

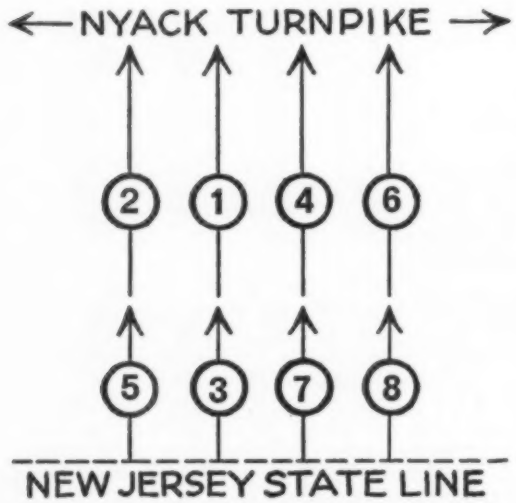


An Expansion Joint Showing Dowels, Pins and the Angle-Iron Frame Developed by the Superintendent for Holding the Joint Firmly in Place When Concrete Is Poured Over It.

inches below the top of the forms and then the welded mats were placed by two steel men. Following this the remaining 2 inches of concrete was spread and the Ord 1924-model finishing machine was brought up to screed and finish the top. The operator shoveled the concrete and grout to the strike-off along one form and a helper shoveled to the screed on the other side. They also watched for any possible overrun of fine aggregate onto the adjacent slab which might cause a bump when the finishing machine passed over the fresh concrete for the second time.

FINISHING THE SLAB

Immediately behind the finishing machine a triangular screed, made of an 8 x 8 sawed through on one diagonal and with pipe handles and a support at either end, was used by two of the three finishers. The screed, according to New York State specifications, is worked diagonally across the fresh concrete at an angle of 45 degrees. This is somewhat of a compromise between a transverse float and a longitudinal float, being more effective than the former and not quite as effective as the latter.



Sequence of Pouring Lanes on the New Greenbush Road

The three finishers used first the triangular screed, then a 12-inch cypress belt, then dragged burlap along the top attached to a 2 x 4. Following this two of the men went back to cut the expansion joint and edge the pavement and finally, after straight-edging the pavement, used the cocoanut fibre broom to give the typical New York roughened surface finish to the slab. One of these men finally swept the edge of the adjacent slab with a wire broom to scour off any fresh concrete or grout which might have adhered to it.

CURING

Following the completion of the broom finish on the new slab, two men spread burlap across the 10-foot slab, keeping it wet until quitting time. The same men stripped the burlap the next morning and put on 6 inches of hay which was sprinkled for seven days, using one man with a hose every 4,000 feet of slab. The hay was initially delivered on the job in 400-pound bales which were distributed along the shoulder. After it had been used on the first slab it was left in place and then merely moved over to the adjacent slab when that was poured.

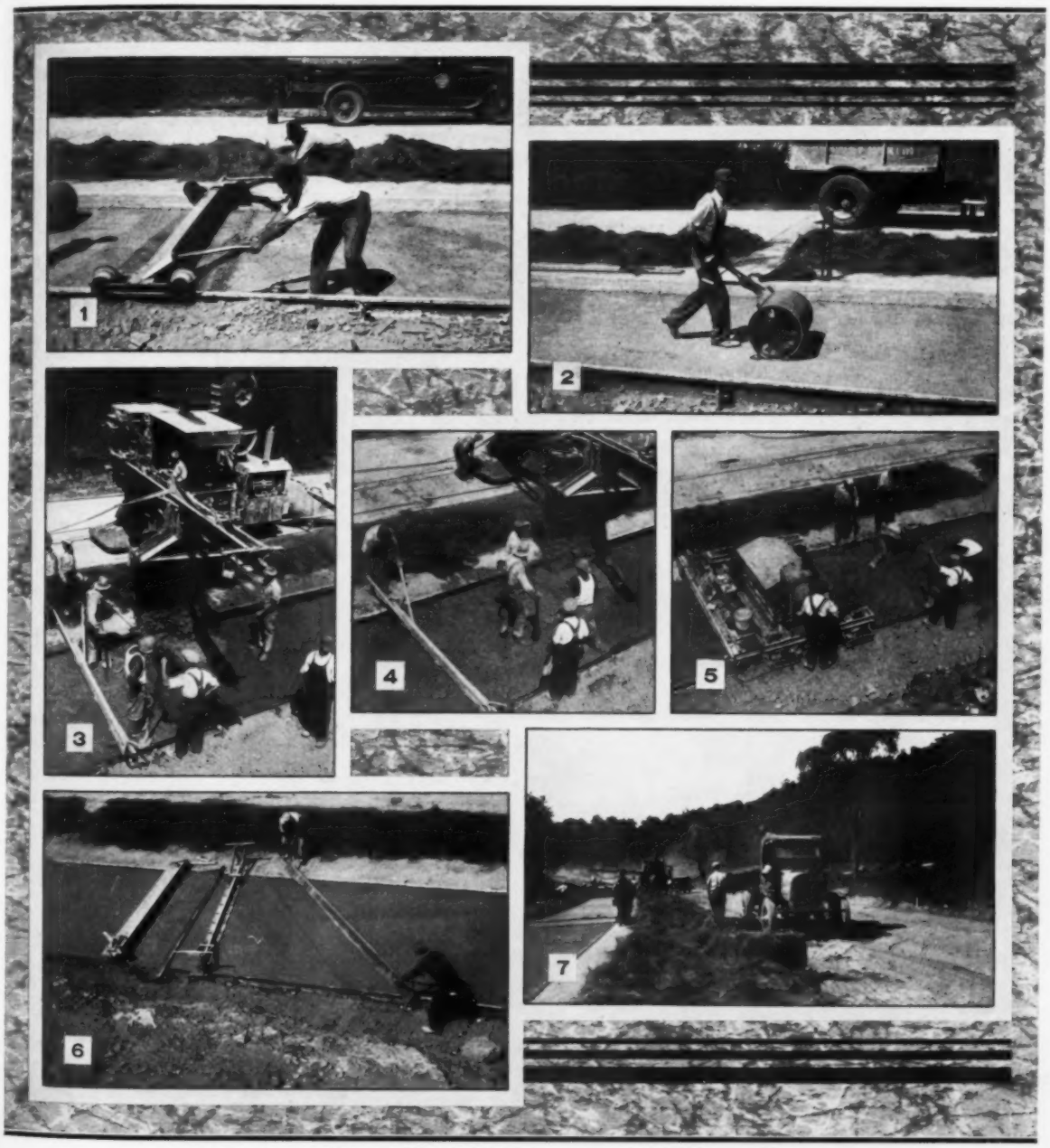
MISCELLANEOUS ITEMS

The accompanying diagram is typical of the manner in which the superintendent handled 10-foot strip paving where there are three or four strips to be poured. The arrows indicate the direction in which the strips were poured and the numbers indicate the order in which they were poured. In pouring strip 4, the paver ran on strip 1, the curing of which was completed. Similarly strip 6 was poured with the paver running on strip 4 and also strip 2 was poured with the paver running on the grade in what is numbered strip 4, reaching over strip 1. This was made possible by the extra length of boom.

The water supply was furnished by a C H & E

triplex pump from a pool formed by an earth and plank dam at the north end of the job. For the middle of the job water was taken from a Spring Valley Water Co. hydrant and paid for at meter rates. A 2-inch iron pipe was run along the shoulder for the entire length of the job with taps spaced at 250-foot intervals. These taps were used both by the paver and for the sprinkling hose, the paver using alternate taps. The paver carried 250 feet of Goodall 1½-inch rubber hose. The Ransome paver carried an auxiliary water tank which held enough water for seven batches. This made it possible for the superintendent to eliminate the second hose which he had previously carried on the pavers on other jobs. The moving of the hose was a simple matter, the concrete foreman breaking the Boss air valve connection, tying the end to his automobile and towing the hose down to the next tap. The time required was seldom more than two batches and never more than four, so that the paver operator scarcely ever knew when the hose was disconnected.

A small sign measuring about 1½ x 2 feet and built triangular, so that it would stand of itself, was made, painted white and then in red the words "Wetting Limit" painted on it. This sign was spotted by the in-



THE WAY S. J. GROVES & SONS HANDLED FINE GRADING AND CONCRETING

1. Pulling the hand subgrader. 2. Hand rolling the fine grade. 3. Pouring concrete across an expansion joint. 4. Pouring the first course which was struck off with the hand screed shown at the left prior to placing the steel. 5. The finishing machine and puddlers. 6. The hand finishers using the triangular float. 7. Spotting the hay for curing.

spector and concrete foreman to insure sufficient wetting and to eliminate unnecessary wetting of the hay cover which was usually left on a slab long after the seven-day specified curing and wetting period.

Gasoline for all of the equipment, including the trucks of the subcontractor who handled the batches, was supplied by the local distributing depot of the Standard Oil Co. of New York. An average of 1,200 gallons per day was furnished to the tractors, compressors and shovels when heavy grading was in progress and about 500 gallons per day for the paving equipment when concreting started. A Socony tank truck supplied gas to the paver and finishing machine about 7 A.M. before the machines were started and then the truck returned about 11 A.M. and supplied gas to all auxiliary equipment, such as the pump and the batch trucks.

Batching at a Commercial Quarry

The preparation of the batches was handled at the West Nyack quarry of the West Nyack Trap Rock Co., a dead haul of about 2 miles from the north end of the job. This being the most feasible location for the batching plant, the superintendent elected to pave the north three-quarters of the job first. The north section of the job had a clay grade and the south section a sandy grade. Thus, if wet weather predominated during the latter part of the paving the trucks would have a finished slab to run over and the sandy subgrade would be improved rather than spoiled by wet weather.

The West Nyack Trap Rock Co. had its own batching plant consisting of a Butler bin, an Erie batcher and a Blaw-Knox bulk cement plant. Stone from the crushers is regularly delivered to the batching plant by a series of belts and vertical bucket elevators. The contractor purchased his batches at the batching plant delivered to the subcontractor's batch trucks. The hauling contractor, Stanley Martin, of National Park, N. J., and Tappan, N. Y., used a maximum of nine Autocar trucks. He was paid by the batch delivered to the paver skip, irrespective of the distance which the batch was hauled. The contractor furnished two men in the box cars to unload the bulk cement to the boot of the bucket elevator with an automatic scoop.

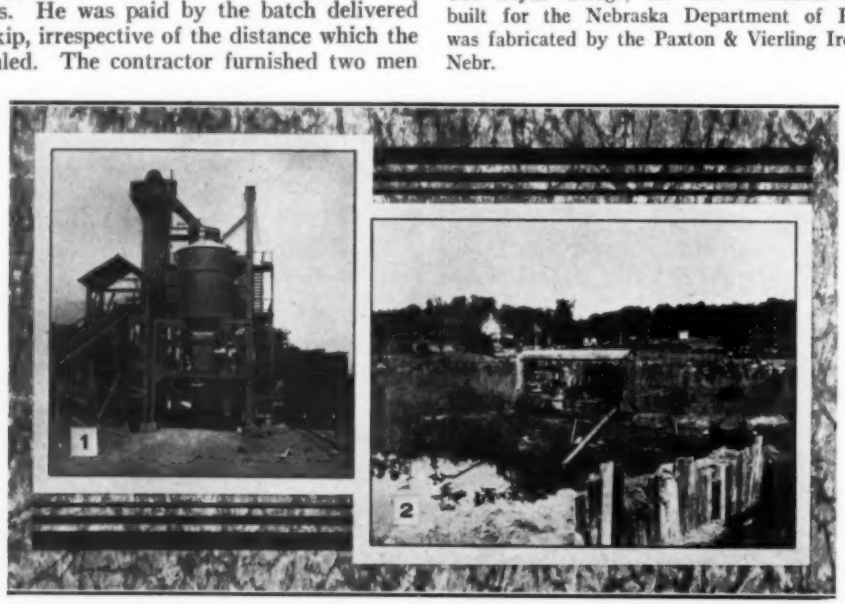
Personnel

On this contract, calling for a 40-foot road laid in four 10-foot slabs for a distance of 5.69 miles, the contractor averaged 1,400 feet of 10-foot strips per 10-hour day with many days, particularly toward the latter part of the job, when 1,800 and 1,850 feet of slab were poured. For S. J. Groves & Sons, Ridgefield, N. J., J. B. Matthews was General Superintendent, S. B. Gardner, Superintendent in charge of grading and culverts, and Walter D. Olsen, Superintendent in charge of concreting. For the New York State Department of Public Works, the project was in charge of J. S. Bixby, District Engineer, with N. F. Ronan as County Assistant Engineer and H. I. Dorfman as Engineer in immediate charge of the work.

Awards for Bridges Made by A. I. S. C.

AWARDS for the three most beautiful bridges built during the past year have been made by the American Institute of Steel Construction to the High Level Viaduct crossing the Hackensack and Passaic Rivers in New Jersey; the French King Bridge over the Connecticut River near Greenfield, Mass., and the Bryan Bridge over the Niobrara River at Valentine, Nebr.

The High Level Viaduct, judged to be the most beautiful monumental bridge, is made up of two bridges, identical in design, which serve as the highway viaduct over the Jersey meadows leading to the Holland Tunnel. McClintic-Marshall Corp., Bethlehem, Pa., fabricated and erected the two bridges, while the approach viaducts were fabricated by the American Bridge Co., Pittsburgh, Pa., and the Phoenix Bridge Co., Phoenixville, Pa. The French King Bridge, judged the most beautiful bridge of medium size, was designed and built for the Commonwealth of Massachusetts. Simpson Bros. Corp., Boston, was the contractor for the substructure and McClintic-Marshall Corp. was the contractor for the superstructure. The Bryan Bridge, the most beautiful small bridge, was built for the Nebraska Department of Public Works and was fabricated by the Paxton & Vierling Iron Works, Omaha, Nebr.



1. The aggregate and bulk cement batching plants at West Nyack. 2. Water was furnished by a triplex pump from a pool formed by an earth and plank dam.

Handling Materials *for a* 350-Foot Concrete Bridge *by* Cableways

Chas. F. Mustard of Mustard-Curry Corp.

Mustard-Curry Building Corp. Bloomington, Ind., Constructed a Highway Bridge in Efficient and Novel Manner

AN economical and efficient manner of handling materials which has been somewhat overlooked by bridge builders was used in the construction of a 350-foot hollow-arch concrete bridge in Turkey Run State Park near Marshall, Ind., by the Mustard-Curry Building Corp. of Bloomington, Ind. While many contractors think of tautline cableways as being suitable only for large projects, this contractor felt that the cost of handling materials for a bridge of this type could be reduced considerably by the use of a light tautline cableway. The bridge was built across a deep ravine for a highway cut-off laid out by the State Highway Department. Every piece of timber, of structural steel, of form lumber and every yard of concrete used in the construction of the bridge was handled by a 2-ton Sauerman tautline cableway.

The Cableway

The cableway span was 460 feet. The head tower and tail tower each was a timber A-frame, 40 feet high with two front and two rear guys. The track cable was anchored to logs in the ground at the rear of each tower. The contractor acquired a used belt-drive hoist and a 50-horsepower gasoline engine which proved to be quite satisfactory as a power unit for the cableway. The hoist had one drum for the hoist cable and a reversible spool for the endless conveying cable that hauled the carriage back and forth on the track cable. The total equipment on the job consisted of the cableway, a concrete mixer, and a portable saw-mill for cutting the form lumber.

Handling Materials

The bridge has a long central arch and two short arches. Excavation for the pier foundations were made by hand labor and the spoil shoveled into the cableway bucket to be transported to a convenient storage space along the span. This earth later was handled again by the cableway to make fills along the pier.

All the piling and timber supporting the forms was handled into place by the cableways and was all taken out the same way, the plan being to postpone pouring the deck until the cableway had a chance to pull out and carry away the entire false-work. A novel scheme was devised for handling the reinforcing steel, which consisted of 1⅛-inch rods 60 feet long. A cradle 20

feet long was suspended under the cableway carriage and the rods were laid in this cradle. Rods of this length and size are hard to handle on any job, but the use of the cableway simplified the task.

In addition to handling all of the material, the cableway proved convenient for hauling men and tools back and forth. The carpenters working out on one of the pier forms required a piece of form timber cut to a certain size. They informed the signal man, who was equipped with a telephone connected with the hoist operator. The piece was quickly cut on the portable saw, and a workman rode out in the cableway bucket to the pier with this piece of timber.

The cableway was called upon several times for unexpected service. When a large concrete mixer was brought in to replace the two smaller mixers which had been installed at the start of the work, the cableway picked up the two small mixers and lifted them out and onto the waiting truck, then lowered the new mixer into place. When a truck delivering gravel became stuck in the gravel dump the cableway pulled it out.

CONCRETING

Just forward of the head tower there was a natural pocket scooped out of the side wall of the gulley. By erecting a timber wall across this pocket a natural storage bin was formed for sand and gravel. The aggregates were brought in by motor trucks from a plant of the Neal Gravel Co. about 29 miles distant and dumped into this natural storage bin. Outside of the wall was located the concrete mixer, sand and gravel being drawn off to the mixer from the storage bin as required. The mixer delivered directly into a concrete bucket handled by the cableway. All of the reinforcing steel and timber came in by road and was stored adjacent to the head tower ready to be transported by the cableway as required.

EDITORIAL NOTE.—The information on which this article is based and the photographs were furnished through the courtesy of Sauerman Bros., Inc., Chicago, Ill.

Handling 60-Foot Lengths of Reinforcing Steel

Boulder Dam Facts That Catch the Imagination

NOT since the Panama Canal has there been such a construction job as Boulder Dam which will tame the wild Colorado River. This river in 60 days carries nearly half as much water as the Ohio River at Pittsburgh does in a whole year.

Preparations for the construction of Boulder Dam are requiring two and a half years before the first concrete is poured in the dam structure. Railroads, highways, tunnels, transmission lines, and a city are built as construction tools. Since April, 1931, the contractors have been busy, but the concrete will not be poured until December, 1934. The dam is 730 feet high, as tall as a 60-story office building, 659 feet thick at the bottom, 1,180 feet long at the top and will create an artificial lake 115 miles long. An 800,000-horsepower electrical generating plant will be installed, to be operated continuously with two-thirds of this capacity. All of the Niagara Falls plants together total 1,600,000 horsepower.

The most impressive work done so far is the driving of the four tunnels which will divert the water while the dam is being built. Each is 50 feet in diameter, from 3,560 feet to 4,360 feet long, drilled through solid rock, and lined with concrete 3 feet thick as described in the November, 1932, issue of CONTRACTORS AND ENGINEERS MONTHLY.

Steam built the Panama Canal, electricity is building the Boulder Dam: 3,250 horsepower of synchronous motors drive air compressors for rock drills and concreting; 1,500 horsepower of direct-current motors drive twelve big electric shovels; 1,000 horsepower of totally-enclosed, fan-cooled motors provide 1,000 tons an hour of washed and graded sand and gravel at the gravel preparation plant; 1,200 horsepower makes concrete, 451 cubic yards of it an hour; 1,000 horsepower goes to miscellaneous pumps, etc.; 3,500 horsepower operates the five great aerial cableways which will excavate the dam site proper, and later place therein 3,500,000 cubic yards of concrete. These cableways alone would attract engineering attention to the Nevada desert, for two have a span of 2,575 feet. They swing from towers, the highest of which rises 90 feet above the rails on which it will travel. Each of the 3-inch locked-coil cables has an ultimate strength of 550 tons. In service 20-ton loads will be lifted at 300 feet a minute, and carried along the cable at 1,200 feet a minute while the whole cableway, towers and all, rolls along its track at 150 feet a minute. Power for the construction enterprise is supplied by a 15,000-kva sub-station at the site.

Protecting Profit in Bad Weather

(*Continued from page 24*)

than because operations are delayed too long. To be profitably handled, modern equipment must be operated at a high rate of output. In the highway field this generally is impossible when ground conditions are bad. Production simply cannot be sustained when weather conditions are adverse, and when it is not sustained cost mounts rapidly. This is inevitable in the relationship governing production throughout the construction field. Moreover, it is universally admitted that depreciation on motorized equipment increases sharply if such equipment is required to operate in the mud. The whole situation, therefore, dictates that where modern equipment is used bad weather delays shall be extended until conditions permit of securing high production. Contractors who have suffered losses through attempts to use modern equipment, particularly modern hauling equipment, will generally find that such equipment will pay handsomely if operation is avoided while adverse weather conditions prevail.

The Editor Comments

Most Proposals to Divert Gas Tax Revenue Have Failed

It is a sign of increasing intelligence or at least appreciation of the burdens of the highway user that proposals to divert the revenues from gasoline taxes to purposes other than the building and maintenance of highways have generally failed in legislatures this winter and spring. In most of the legislatures of the forty-four states which were in session during the early part of the year, bills were presented to utilize this revenue for various purposes but in only four were the bills passed. Proposals to increase the state gasoline taxes were also rejected in many states in which they were offered. The only actual increases were in Florida, Tennessee and Oregon. A special, and as yet unique, tax was provided in Maryland, authorizing the collection of 4 cents a gallon on all gasoline used by non-resident-owned trucks on which the Maryland tax had not been paid.

The diversion measures which were adopted permitted Clay County, Ala., to use 20 per cent of the gasoline tax turned over to it, for school purposes. In South Dakota, one half of the proceeds has been diverted to the Rural Credits Fund and the extra 1 cent voted in Florida goes to the General Revenue Fund. The diversion in Tennessee affects only counties of a certain population. In such counties one half of the gasoline tax proceeds may be used for whatever purpose the local authorities may desire.

Such organizations as The American Road Builders' Association, the American Automobile Association, the National Highway Users Conference, and local automobile clubs have been most active in smothering the attempts of ambitious politicians to take the legitimate tax on the highway user away from its proper use on the highways and apply it to the popular vote-getting procedure of relief. We do not decry legitimate relief projects, of which highway construction is one of the most admirable, but applying pressure to but one class of taxpayer for relief work is unwarranted.

One Hundred Thousand Men Back at Work Within Six Weeks

According to information just received from the Federal Emergency Administration of Public Works, at least 100,000 men will be at work on road construction throughout the nation within six weeks. The initial $400,000,000 for roads became available July 1 under the Public Works Act. Carrying out the administration's liberal policy of speeding the plan into effect without sacrificing safeguards, allocations to states were made at the earliest possible moment. According to Colonel Donald H. Sawyer, temporary administrator of public works, the number of newly employed men will increase steadily as state and local highway programs develop and are approved. September will probably witness the peak of operation. The advent of cold weather will not halt work for Federal highway engineers plan work which will not be effected by low temperatures to be pushed during the winter months.

Many states acted in anticipation of the Federal recovery program by mustering engineering forces in advance to complete the plan of work. The effort of the administration is to transform the Federal funds into wages as soon as possible and continue transformation at top speed as far as possible and funds permit.

Not more than 50 per cent of the funds available will be applied to the extension of the Federal Aid system outside corporate limits. The remainder will be expended on secondary or "feeder" roads and for extension of the Federal Aid system into and through municipalities.

Inflation for the Contractor

For a number of years the prices bid for concrete road work have been decreasing until most contractors are working for the fun of it. With the keen competition in this field, the contractor has had to sharpen his wits in every way and use the most modern equipment to keep up and make the necessary savings. With unemployment relief labor on the job the contractor has found that he is having a bigger fight to keep going on present prices.

There is a sizable group of contractors who believe that there has been a general letting down in the specifications, such as the elimination of the longitudinal float in some states, so that the jobs are not up to the quality products of a few years ago. This has had its reaction on prices and has not helped them to increase but has tended to beat them down lower than ever. Can not the contractors as a group or through their associations demand that the specifications be adhered to with greater vigilance and tightened rather than slackened, for through this prices will be forced upward by the necessity of better work which can not be done cheaply. It will be self-motivated inflation and will start the ball rolling upward toward better prices for all operations.

Theodore Reed Kendall

Legal Points for Contractors

These brief abstracts of court decisions in the contracting field may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt consult your own attorney

Edited by A. L. H. Street, Attorney-at-Law

Association Contract Fee Held to Be Illegal

Even if one-half of one per cent alcoholic content in a beverage does not make it intoxicating, a one-half of one per cent rake-off by a contractors' association on contracts is illegal, according to the decision announced March 7, 1931, by the Kansas Supreme Court in the case of Master Builders' Association of Kansas v. Carson, 296 Pac. 693.

A by-law of the association required members securing contracts in the state amounting to $10,000 or more to pay out of the first estimate a sum equal to one-half of one per cent of the contract price. Half of the fee was to be distributed among the five lowest bidders.

Carson refused to pay $168.88 due from him under this by-law and suit followed. The district court at Cherryvale, Kan., and the Supreme Court, on appeal, ruled that he was not liable —that the by-law was illegal, being against public policy in its tendency to increase contract prices. The courts followed this reasoning of the Kentucky Court of Appeals in a similar case.

"A contract by members of a voluntary contractors' association assessing a fee upon each member of a percentage of the contract price of any public contract price of any public contract secured by him is against public policy and void, regardless of lawful intent of the parties in making it and of the further fact that the public may not have been injured in a particular instance." Kentucky Association of Highway Contractors v. Williams, 45 A. L. R. 544.

The principal objection to the by-law found by the Kansas Supreme Court was thus expressed.

"Knowing human nature as we do, this court is bound to assume that the contractor bidding on a job, knowing that he will be called upon to pay one-half of one per cent of the contract price to a stranger to the contract, will add that amount to his bid. . . . This must be paid by the consumer."

Specially objectionable, the court said, was the provision for disbursing part of the fee amongst unsuccessful bidders, thereby indirectly charging the owner to them, although they have performed no service.

The Supreme Court brushed aside a contention that the fee payable to the association was justified by engineering and quantity survey service rendered by the association to its members.

An Important Phase of Public Construction Contracts

"Won't you let me off on that $20 per day penalty mentioned in our paving contract?" asked a paving contractor of county commissioners. "You know that delays in getting material, for which I was not at fault, were the real cause of the delay."

"All right, Contractor, we'll be good fellows and let you off," replied the commissioners.

"But wait a minute," said a taxpayer who was standing by. "Don't be so free about giving my money away, Commissioners. I hired you to save my money; not to give it away.

"Oh, you go chase yourself," said the contractor and the commissioners in unison. "Taxpayers, like children, should be seen and not heard."

But Taxpayer was persistent and he sued the county and the contractor to prevent surrender of the county's right to the $20 per day.

In an opinion filed May 29, 1931, in the case of Hillsborough County v. Pal Mere, 135 So. 525, the Florida Supreme Court said that since the contractor had no legal excuse for delayed performance, he was not entitled to be let off from the $20 per day obligation. Every public contractor will do well to remember the following remarks made by the Florida Court in this case:

"It is well settled that, where a contract is made for public improvements, which provides for a certain time for completion, such time of completion cannot be waived by the public authorities to the prejudice of taxpayers after a breach has occurrred. In such cases the rule is that a taxpayer has the right to stand on his original rights and demand that the contract be enforced as written. . . .

"The county commissioners of Hillsborough County were under the duty and obligation to see that the contracts made were strictly complied with. They also had such rights to grant and make such concessions in favor of the contractor as were expressly reserved in the contracts themselves, but no others. Embargoes and other contingencies might have been good causes for which they could have granted extensions during the course of performance, but the contractor failed to ask for any such extensions within such time. Neither did the county commissioners undertake to take cognizance of the situation and grant an extension without request. . . .

"The county commissioners beyond doubt acted in good faith in extending leniency to the contractor, and the contractor appears to have had reasonable excuse for his delay on account of embargoes, but, at the same time, the contract itself fixed the rights of all the parties in interest, including the taxpayers. The rights of the taxpayers cannot be granted away to their prejudice in favor of the contractor, regardless of the merit of the contractor's claim, unless the contract itself authorizes such action."

Discharging Attorneys

A decision of the New York Court of Appeals shows that, in that state at least, one, by hiring an attorney, does not bind himself to retain his services one instant longer than he desires them. And this is so, even if there is a contract for the lawyer's services throughout a given case or period.

The court rests its decision upon the ground of "the peculiar relationship of trust and confidence which ought to exist between attorney and client." In other words, a client does not have to take his attorney "for better or for worse." He need not assign any reason for dismissing his attorney, for he is the sole judge whether he ought to be satisfied with the lawyer's services.

But the court also recognizes that if an attorney be dismissed without just cause he may recover the reasonable value of his services rendered to the date of discharge. The opinion also intimates that in some of the other states, the rule prevails that a wrongfully discharged attorney can recover damages covering the loss entailed by his being prevented from carrying out the contract of employment, as well as for services performed to the date of discharge.

How the Other Fellow Did It

Ideas That Have Already Proved Helpful to Contractors

Only Empty Wheelbarrows Were Moved on This Job

240. Somewhat akin to the story of the man in the insane asylum who always wheeled his wheelbarrow upside down so that he would not have to carry a load is the story of a mid-west contractor who used wheelbarrows for lip curb concrete. These were spotted at 10-foot intervals along the shoulder and filled as the paver passed by. As soon as a wheelbarrow was emptied, it was wheeled along the shoulder to the next empty place in line and again filled when the paver passed it. This is much more sensible than to make a man break his back trying to push a loaded wheelbarrow along a rough shoulder every few minutes. 24.4.36

Watch the Grout When the Paver Runs on an Old Slab

241. With the amount of new construction at a minimum today, contractors are watching more closely for chances to bid on widening projects. This work entails somewhat different operations, particularly as the widening strip is seldom more than 5 feet wide. Thus, the road job is strung over a longer distance in proportion to the amount of concrete poured. Further, the paver usually runs on the old slab. An item which every contractor must watch is the spillage of grout from his paver bucket on the concrete. One contractor whose job we examined closely equipped the paver with a galvanized iron pan under the loading position of the bucket, which caught all of the small leakage of the grout which seems to be inevitable with any type of bucket. Thus none of the grout was lost, as the mixer oiler shoveled it over into the slab from the pan at frequent intervals, and also the old slab was not messed up with a lot of grout spots. 24.2.19

A Truck Checker and Utility Man

242. We have spoken in these columns several times of efficiency men who kept track of various operations for the contractor. On one Minnesota job the checker also acted as a utility man. He was located on a small platform about 100 feet from the cement dock and one of his jobs was to cover the bulk cement with some of the sand from the batch when the wind was excessive. He also checked the time of the trucks, their numbers, and gave each truck driver a ticket, which was the basis of payment for the hired trucks and gave a close check on the contractor's own fleet, which mingled with the hired trucks and set the pace. 24.3.34

Fine Grading Ahead of Form Setting

243. A contractor in the middle west has conceived the idea that it is better to practically complete the fine grade before the steel forms are set for the concrete slab. Most contractors consider that fine grading starts with the setting of the forms. This contractor put a 35-horsepower tractor with a 9-foot blade and a rooter out in front of the form setters to see that the grade was almost 100 per cent accurate. The advantage of this scheme is that the grade is wider ahead of the forms and the equipment can operate more quickly, turn more easily and cause less delay to the trucks. The rooter was used by this contractor because of the easy control of the rooter teeth through a wheel instead of the usual levers. 24.4.34

Special Spades for Use Against the Forms

244. Practically all concrete paving specifications require spading of the concrete at the forms to prevent honeycombing. Usually the regular shovels used by the puddlers are employed for this purpose, but we have seen jobs where long narrow perforated spades such as are used in spading concrete on thin partitions in buildings were employed. A Minnesota contractor uses long flat hoes made of plates of steel about 2½ inches high and 18 inches long with a steel bar for a handle. These hoes, used along the forms, leave a clean smooth edge, with no sign of honeycombing, and are easier to use than the usual square end shovel. 24.3.34

A Crude But Effective Bulk Cement Handling Plant

245. Two or three years ago a Wisconsin contractor had a particularly advantageous set-up for handling bulk cement on the side of a steep cut. The bulk cement was delivered to the hopper by driving the cement truck on top of the cut and the batch trucks ran at grade. Since such a happy combination is not always possible he developed a standard plant which he could use on flat or hilly country. He built a trestle or ramp up which the cement trucks backed to an elevated hopper and dumped into the hopper direct. The hopper was lined with sheet metal to permit the cement to slide easily to the control gate through which it ran to the buggies. The first hopper was built rectangular in form for the top section and then sloping from all four walls to the control gate at the bottom. This was later changed to a straight wall at the front and the other three walls sloping from the top to the control gate. This gave a minimum of corners where the cement could pack. The back was an equilateral triangle and the others right angle triangles with the right angle at the top and front. Three men handled the cement and the batch trucks usually drove through a depressed roadway. 24.2.25

A Novel Bracing Method for Side Walls in Underpass

246. A contractor building an underpass for a main highway near a river bank developed an interesting and effective method of bracing the side wall forms. It was necessary to pour the pavement slab or invert first and later to pour the side walls which were faced with granite. When the roadway foundation slab was being poured 4 x 4-inch wood blocks were set in the concrete when it was soft and the 3 x 4-inch braces for the granite facing of the side walls were set up at an angle of 45 degrees at varying distances from the wall against these wood blocks. The blocks were later chipped out and the spaces filled with concrete. 24.2.43

Maintaining Industrial Railway Track

247. Operating an industrial railway on a 14-mile paving job calls for constant track maintenance to prevent delays through derailment. Most contractors will scatter a fairly large gang of track men over the sections being used intensively. An Iowa contractor whose job we covered made it possible for two men to do this work by providing them with proper tools and a miniature edition of a two-man railway hand car. 24.3.24

Construction Industry News

The Gunitor Co., 1227 W. Beardsley Ave., Elkhart, Ind., has been formed to produce a new line of machines for the pneumatic application of concrete and cement to structural steel, to old concrete, brick, tile and wood structures and similar work. C. L. Dewey is President and General Manager, W. McKay White is Vice President and Sidney L. Dewey, Secretary.

T. L. Smith Co., Milwaukee, Wis., is now in receivership and will be operated entirely separately from its former affiliated company, National Equipment Corp. Harold E. Smith, who has been appointed receiver, was President of the T. L. Smith Co. from 1916 to 1930, and the present staff is composed as far as possible of the men who were associated with him while the company was under his management. The company is now in a position to service any of its machines now in the field or to fill orders for repair parts and new machines.

Smith Booth Usher Co., Los Angeles, Calif., has announced the election of the following officers at a recent stockholders' meeting: President, Carl E. Baker, to fill the vacancy occasioned by the death of H. P. Usher; Vice President and Treasurer, J. R. Hoffman; Secretary, F. B. Whittam; First Assistant Secretary, F. E. Anderson; Second Assistant Secretary, W. E. Meisel, and Assistant Treasurer, L. Engi. Mr. Baker, the new President, has been Treasurer and General Sales Manager of the company for a number of years as well as directing the activities of the Construction Equipment Division.

Link-Belt Co., Chicago, Ill., has recently appointed the following distributors for its shovels-cranes-draglines: W. M. Smith Co., 4601 First Ave., N., Birmingham, Ala., and John J. Crumbaugh, Alexandria, Penna.

Coppus Engineering Corp., Worcester, Mass., has announced the appointment of the Blower Application Co., 918 North Fourth St., Milwaukee, as distributor for Annis industrial and ventilating filters in the state of Wisconsin, excluding Florence and Marinette Counties.

Young Radiator Co., Racine, Wis., manufacturer of Young Streamaire copper convection radiators, unit heaters, blast cores and other heat transfer products for air conditioning, has announced the appointment of M. F. May as Sales Manager of the Heating Division. Mr. May has had a long experience in practical engineering and sales work in the heating field.

Sullivan Machinery Co., Chicago, Ill., has announced that the St. Louis district sales office, formerly located at 2015 Railway Exchange, and the warehouse formerly located at Mt. Vernon, Ill., are now combined under the direction of D. M. Sutor, Manager, at 2639-41 Locust Ave., St. Louis. A complete stock of parts for air compressors, hammer drills, drill sharpeners, hoists, coal cutters, coal loaders, cutter bit sharpeners and diamond drills will be carried.

Chain Belt Co., Milwaukee, Wis., has announced the appointment of Edgar Stilley as its direct factory representative in the states of Maryland, North Carolina and Virginia, with headquarters at 210 Snow Building, 31 So. Calvert St., Baltimore, Md.

A Dangerous Practice in Blasting Operations

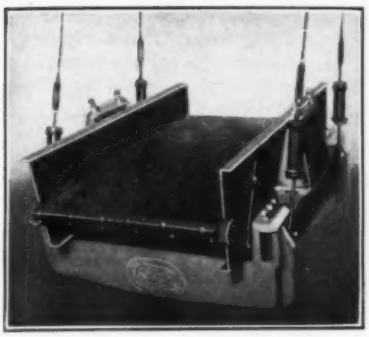
A DANGEROUS practice in blasting operations is loading bore holes with black blasting powder immediately after the hole has been sprung or dewatered with dynamite, according to the Institute of Makers of Explosives. From reports which have been received, this sometimes results in premature ignition of the black blasting powder and is thus responsible for accidents. On several occasions, blasters have been injured by premature explosions caused in this manner and investigation disclosed that the holes had been charged with black blasting powder immediately after they had been sprung with dynamite.

In open pit operations where deep holes are sprung, the danger of causing premature explosions by loading explosives in a sprung hole too soon after springing is well recognized. It appears however that where only small charges are used, this danger has not been recognized and premature explosions occur. The temperature of explosion of high explosives is extremely high and is considerably above the temperature required to ignite black blasting powder. Part of the hot gases produced by the explosion not only remains in the bore hole, but heats the surrounding walls of the hole and if an explosive is put in the hole immediately after springing, the high temperature very probably will ignite the charge. Therefore, before further charges are introduced, sufficient time should elapse to cool the hole well below the ignition temperature of an explosive.

The Economics of Highway Improvement

A BOOKLET of 20 pages of the size of a standard letterhead and including tables, formulae and computations has been issued by the Portland Cement Association, 33 West Grand Ave., Chicago, Ill. This technical treatise of the economics of highway improvements is prepared in such a way that highway engineers can apply it to their own traffic, construction and maintenance problems and quickly determine where and how to build roads. It summarizes the work of the Highway Research Board in developing the tests and details needed to place road building on a sound business basis. The essential findings of the committee on the Economics of Highway Improvement are assembled here for the first time under one cover, and are applied to a practical solution of road building problems. Copies may be secured without cost by writing to the Portland Cement Association and mentioning CONTRACTORS AND ENGINEERS MONTHLY.

A Byers Model 40 3/8-Yard Shovel Making a Cut on the Rio Linda Road, Sacramento County, Calif. This Equipment Was Sold by the Edward R. Bacon Co.



The Trayco Single Deck Screen

Electric Vibrating Screens

AN electric vibrating screen with no mechanical moving parts and which is easily installed and operated is made by the Traylor Vibrator Co., 1400 Delgany St., Denver, Colo. The Model FB Trayco screen, which is sturdy, reliable and compact, is built for fine and coarse mesh heavy-duty screening problems. It is built in single and double deck styles, with uniform full-surface vibration, 3,600 per minute on 60-cycle current, with positive pulsating vibration obtained directly from the electric current. A small motor generator in a steel cabinet with a convenient safety switch, panel board, rheostat and ammeter is furnished with 50 or 60-cycle screens. Auto regulators are supplied for 25 and 30-cycle screens.

All Trayco screens are suspended with vibration absorbers attached to rods. Vibration is absorbed before entering the building structure from which the screen is suspended. The vibration absorber hangers have turnbuckles and one extra set of wire screen angle clamps are included with each screen. The absence of bearings simplifies all dusty, abrasive and wet screening problems. The screen mesh is easily applied and has long life. A simple wire tightening device securely holds the wire mesh while rigid cross-rib members properly support the screen mesh and prevent whipping. The screen surfaces can be changed in a few minutes.

Heavy Oil Engines for Trucks and Industrial Service

A LICENSE arrangement has just been concluded by the Waukesha Motor Co., Waukesha, Wis., with the Hesselman Co. of Stockholm, Sweden, for the American rights under the Hesselman oil engine patents. Under these patents the Waukesha Motor Co. will manufacture a line of heavy oil engines for truck, tractor and general industrial service. The Ingersoll-Rand Co. has held a similar license for use in portable air compressors, and for more than a year these engines, built by the Waukesha Motor Co., have been on the market. Several hundred are reported to have been exported to Europe as well as to the Orient.

These engines occupy a place midway between the automotive diesel engine and the gasoline engine. They burn the same fuels as a diesel engine, but use electric ignition. They show slightly less fuel economy but they weigh less so that in automotive work, they are on almost even terms.

The Hesselman cycle is a distinctly different principle from any of the previous heavy fuel-oil engine cycles. Its operation is extremely simple and readily understood. On the intake stroke, the cylinder is filled with air only, the amount being metered through a balanced throttling valve, and proportioned to the load requirements. A specially-designed intake valve directs the air and imparts to it a rotary movement in the cylinder. The air is compressed to a greater degree than in a gasoline engine, but not to the same extent as in a diesel. At the top of the compression stroke, a high pressure Bosch injection pump delivers a quantity of heavy fuel, the correct amount to insure complete combustion being controlled by mechanical linkage with the air throttle. The fuel is injected through special Hesselman injectors which throw it into the rotating air stream where the fuel mist is intimately mixed with the air. At this moment, the spark plug fires the fuel mixture. The unusual success of this cycle is said to be due to the special features which keep the mixture ratio in the zone surrounding the spark plug always within the necessary limits for instantaneous combustion independent of the engine load or speed. At the end of the power stroke, the exhaust valve opens and releases the burned mixture, and the cycle is repeated.

A Curing Blanket for Concrete Pavements and Slabs

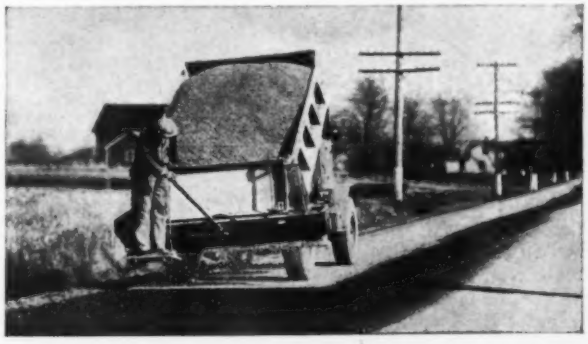
TO furnish a material which will hold moisture in a concrete slab for a longer period than ordinary burlap and thus insure a better and more even cure for the concrete, the Insulation Division, Western Felt Works, 4029-4117 Ogden Ave., Chicago, Ill., has developed the Westfelt curing blanket. This blanket is made of a filler of jute fibres, the same material from which burlap is made, punched or needled between two layers of burlap. This, in turn, is coated with a rubber latex, making the blanket slightly waterproof and retarding the evaporation of moisture from the concrete.

Westfelt curing blanket is made in standard sizes at a slightly greater cost than the price of plain burlap. The method of manufacturing, however, adds to the life of the blanket, which can be handled and used repeatedly on many jobs over a long period of time.

An Improved Sand and Stone Spreader

IMPROVED models of the G. S. C. Hi-Speed spreader, the manufacture and sale of which have recently been taken over by the Syracuse Road Machinery Co., Syracuse, N. Y., have been announced by that company. This spreader which is designed for use in road repair and maintenance, handles gravel, sand, cinders, crushed stone and calcium chloride at any speed and with an even spread.

The unit can be completely attached or detached in a few minutes by one man. The width of the spread varies from 1 to 8 feet and the depth ranges from a light sprinkle to several inches. The truck is operated either forward or backward with even spreading in either case. The power take-off assembly is universal to all truck wheels.



The G. S. C. Hi-Speed Spreader for Sand and Stone

The Kinney Emulsion Sprayer in Use by the Massachusetts State Highway Department

A New Emulsion and Cold Patch Pump

A SMALL pumping unit for applying cold patch and asphalt emulsion under pressure directly from the drums to the road has recently been produced by Kinney Mfg. Co., 3529-3541 Washington St., Boston, Mass. This unit consists of a Kinney pump with a capacity of 10 gallons per minute especially designed for pumping emulsion. A strainer is provided on the suction side of the pump, which is driven by a 1½-horsepower air-cooled gasoline engine with a spur gear speed reducer and a gear guard. The pump and the engine are connected through a Kinney disc-actuated spiral clutch. A suction hose, patching hose, spray nozzle and shut-off cock, and relief valve are supplied with the unit.

The total weight is only 220 pounds, making it easily possible for two men to place it on a truck or trailer. A typical unit consists of a light truck or trailer with five or six drums of material. The plugs are taken off the end of the drum, the suction hose inserted and the material applied to the road under pressure. One of these units will apply six drums of material in about 35 minutes. Considerable material is saved as compared with hand pouring and the material is applied more evenly under pressure and work progresses approximately six times as fast as when hand pumps are used.

A New Ball-Bearing Saw Rig

ALL types of cutting found necessary on construction jobs including ripping, cross cutting, dadoing, mitring, bevel cross cutting, double mitring and bevel ripping can be made with the new Rex No. 5 ball-bearing saw rig announced by Chain Belt Co., 1666 West Bruce St., Milwaukee, Wis. The saw rig has a tilting table with a straight-line cut off and adjustable arbor shaft.

The new No. 5 rig is powered by a 10-hp, 4-cylinder gasoline engine with the engine crankshaft riding on ball bearings. The arbor shaft is also mounted on two ball bearings, practically eliminating vibration. The new unit is built with a welded steel frame much lighter than the old cast iron frame, and with the new engine a more uniform flow of power is maintained.

The smaller size, the No. 3 saw rig, the only machine in its class with a patented tilting table, is only 28 inches wide and can be easily wheeled through any standard doorway and from room to room in any building while under construction. After developing the No. 3 and No. 5 rigs the Chain Belt Co. began a campaign to find out just what these portable rigs could do besides cut wood. Many industrial concerns and contractors have found a use for them and they are placed in the maintenance department, carpenter shop and on the shipping floors of many companies. While they are regularly powered with gas engines, they may be powered with motor power equipment for this type of work where desired. A new feature of the Rex saw rig is that it can be used for marking and cutting various kinds of tile, concrete, bitrous waterproof tile, and other types of combination blocks. To do this, the standard saw blade is removed and an abrasive disc about 8 inches in diameter is substituted, requiring less than 5 minutes time. The tile or block is placed on the saw table and the disc is then run through the material. The material can be marked for accurate breaking or can be cut through completely.

A Tractor-Derrick for Handling Materials in Yards and Depots

A NEW tractor-derrick for lifting or moving materials and equipment of all kinds in the field, in yards and in storage depots has been announced by R. G. LeTourneau, Inc., Wilson Way at Roosevelt, Stockton, Calif. The machine is intended for use in piling, loading, unloading, moving and handling equipment and supplies, for laying pipe lines of all kinds, ripping up abandoned street car tracks, setting or removing poles, erecting small and medium bridge members or other structural steel, placing and moving elevated transformers and in general performing all the functions of a light locomotive crane.

The boom can be dismounted from the tractor-frame by removing two hinge pins and the tractor-frame can be removed from the tractor by loosening six bolts. It is not necessary, however, to remove the tractor-frame in order to use the tractor for other work, for the tractor can be used for hauling while the entire derrick is mounted on it. About 20 minutes' time is required to dismount the derrick.

The tractor-derrick is operated by the regular double-drum LeTourneau power control unit, one drum raising or lowering the boom and the other, the fall line. The regular tractor operator controls the derrick with the normal control levers of the power unit. Although light in weight, the derrick is strongly constructed. Its rated maximum lift is 10,000 pounds. It is of welded steel construction throughout and all sheaves are carried on high-duty Hyatt roller bearings. It can be taken practically anywhere a tractor can go and may be operated wherever a tractor can get fairly solid footing. With the addition of a hammer and guide, this unit can be used as a pile driver.

A LeTourneau Tractor-Derrick at Work in the Field

The New Austin Model 77 Motor Grader

A New Model Motor Grader

A NEW motor grader powered with a six-cylinder engine which develops 53 horsepower at governed speed has been announced as the Austin Model 77 by the Austin-Western Road Machinery Co., 400 No. Michigan Ave., Chicago, Ill. There are six speeds forward, ranging from 1.39 to 13 miles per hour, and the full dual drive puts all power to work behind the blade. The four drive wheels grip the road surface to provide freedom from wheel slippage and miring. The 80-inch wide front axle resists side draft, increases stability and makes the machine easier to handle. The wide tread permits the motor grader to do ditch work with one wheel moving along the top of the road while the opposite wheel in the ditch tracks with the rear drivers. The Z-bar gooseneck, the overall length of which is 96 inches, has a heavily machined, ball-joint, non-chatter draft connection. The circle, which is 60 inches in diameter, provides more leverage when operating the blade and has a five-point support. Wide blade arms are welded to the circle, and both blade raising rods and hydraulic rams for operating the circle have over-size finished ball and socket joints. Rugged ball and socket connections are also employed for joining the blade arms to the blade. The frame is of 9-inch channel construction and has welded steel plate bracing to resist strain and twist.

The Model 77 is also built with single drive. These graders can be furnished with either hand or hydraulic power controls and the dual drive can be furnished with diesel motors. Extra equipment including special blades, boots, extensions, scarifier, power drag attachment, tire pump, snow plow, head and tail lights, etc., are available to meet every operating condition.

Jacks for Construction Service

IN the course of construction work, contractors are called upon to use various kinds of jacking devices not only for making repairs on construction equipment but also for raising forms, bridges, and for pulling posts and poles. The Joyce-Cridland Co., Dayton, Ohio, manufactures several jacks for these types of work.

The Joyce No. 77 which is a standard tool with utility companies for pulling, straightening or moving poles is of the automatic lowering type with an additional tripping feature so that the lifting rack can be dropped when not supporting the load. The jack can be securely locked to the hinged base by means of a sturdy foot-operated pawl.

Hydraulic jacks from 20 to 100-ton capacities, designed for extremely heavy lifting, are used for moving bridges, heavy machinery and steel forms. They are built in two types—"A," the ground-lift single-speed, inside-pump type, and "B," a triple-speed, outside-pump type.

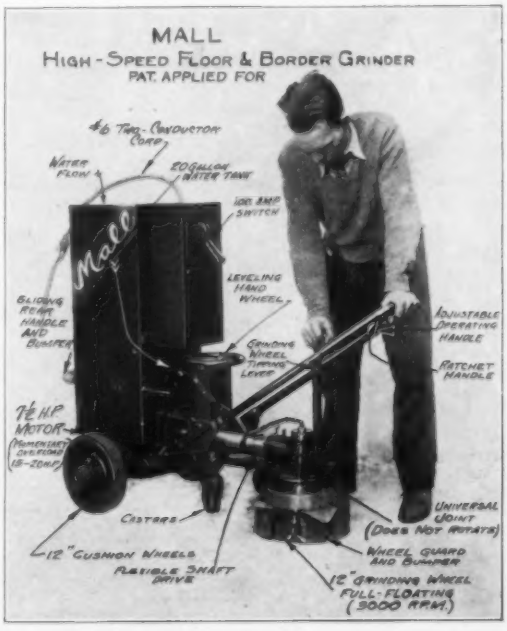
There is also an air motor-driven, ball-bearing, geared-screw type jack hoist in capacities from 15 to 100 tons for raising loaded cars and bridges and for pipe and culvert pushing. Compressed air replaces man-power for jacking with this hoist and saves approximately nine-tenths of the time required for jacking a load by hand. The jack has automatic shut-offs assuring safe operation and it is lowered by reversing the motor. It is powered with heavy-duty Ingersoll-Rand motor and has Alemite lubrication.

A New High-Speed Concrete Surfacer

A HEAVY-DUTY grinding machine, which is said to be the only one using the modern high-speed Bakelite abrasive wheel, has been announced by the Mall Tool Co., 7740 So. Chicago Ave., Chicago, Ill. This high-speed wheel makes possible efficient grinding at 9,000 surface feet per minute but in practice in concrete surfacing, the grinding or rubbing speed is about 800 feet per minute. This machine carries a small tank from which water is fed through the center of the wheel spindle and is thrown by centrifugal force out between the grinding wheel and the surface being ground, keeping the abrasive surface clean and free cutting. The water also acts as a cooling agent to prevent heating of the material which is being ground. The 20-gallon water tank supplies enough water for two or three hours of continuous grinding.

The machine is quickly and easily rolled from place to place as it is mounted on four anti-friction casters and wheels. It is a radical departure from old practices for finishing concrete, terrazzo, brick and marble floors. It will also quickly power-grout with a mixture of fine sand and cement to fill up pores and crevices exposed by grinding. Where electric current is not available, this machine is powered by a 6-horsepower air-cooled gasoline engine.

For highway grinding the new Mall high-speed grinding machine will not only smooth the surface and remove the bumps but will also power-grout the surface, protecting it against weather and other corrosive forces.



Detachable Rock Drill Bits

The Ingersoll-Rand Jackbit

NEW detachable rock drill bits known as Jackbits have been announced by Ingersoll-Rand Co., 11 Broadway, New York City, as a economical solution of the drill steel problem for small contractors, quarries, and public utility companies where the operation of a sharpener and blacksmith shop is not warranted, or where the handling of machine-sharpened drill steels is unusually difficult or expensive.

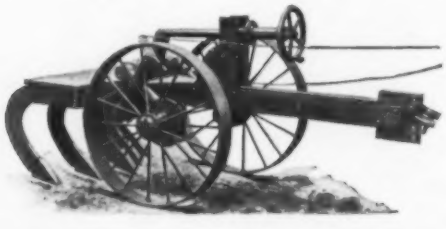
These Jackbits are fastened directly to the end of the drill rod by means of a shallow, reverse buttress-type thread which keeps the bit tight while in use and makes it easily detachable for changing. The maximum hammer blow is transmitted through the end of the rod, close to the cutting edge, and there is no pressure on the threads. Other features are large clearance grooves to pass cuttings from the bottom of the hole, a counter-sunk hole in the center of the cutting edge which acts as a pilot to guide the bit, and cadmium plating to prevent rusting and to give a bright finish which minimizes the loss of bits.

The hollow drill rods for Jackbits are made by the super-smooth-hole process which has long been the Ingersoll-Rand standard. This method of manufacture is claimed to provide a smooth, uniform hole through the total length of the rod and to eliminate fatigue cracks and detrimental corrosive action which might result from a rough hole surface.

A Heavy-Duty Road Rooter

A HEAVY-DUTY road rooter for breaking up old macadam, gravel, oiled roads and streets, and also for loosening earth to be moved by graders or scrapers in the construction of fire breaks, reservoirs, dams, airports and railroads has been announced by Galion Iron Works & Mfg. Co., Galion, Ohio. This rooter has a heavy plate frame of all-welded construction and the wheels, axle and standards are built unusually heavy so that the rooter may be used behind the largest tractors.

The tooth points are manganese steel castings and are reversible for self-sharpening. Any of the teeth can be removed to suit the power of the tractor, or if working in rocky soil, to permit the passage of large rocks. The rooter is adjustable to cut from 1 to 12 inches deep and when cutting full depth, the frame has a ground clearance of 12 inches. The drawbar is adjustable to conform with the tractor with which it is used and to increase or decrease the depth of the penetration of the points.



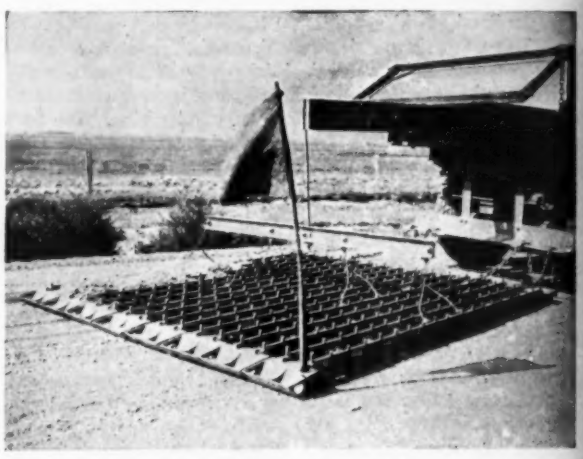
The New Galion Heavy-Duty Road Rooter for Breaking Up Tough Subgrades

The rooter is raised and lowered quickly by two ropes extending to the tractor operator's position. One rope is attached to the lifting dogs which engage the wheels. By pulling this rope, the teeth are lifted out of the ground by the wheels and locked in the raised position. The other rope operates a cam which unlocks and lets the teeth fall to the ground.

This rooter cuts to a width of 48 inches, has an overall width of 57½ inches and weighs 5,800 pounds.

A New High Speed Tool for Dry Road Maintenance

COMPLETE control of corrugations and striking economies in dry road maintenance are claimed for the Denver Road File, which has been developed by The Automobile Storage Elevator Co., 304 Flatiron Bldg., Denver, Colo. This tool consists of a number of blade-like sections, each section being made up of an assembly of alloy steel castings which support and clamp the hardened special steel teeth. One through bolt clamps the entire assembly and the sections are joined into a complete tool by means of flat steel springs which contribute the lateral flexibility which assures conformation to the road contour, and which permits operation at high speeds without jump or chatter. The teeth are clamped with a pressure which permits driving them down with a light hammer, but such that road shocks will not drive them back. Thus the only tool required for normal adjustment and take-up for wear is a hammer.



The New Denver Road File

The blade assembly is 5 inches in width and the teeth are made 8 inches in length. When a tooth has been worn and driven down until its upper end is flush with the top of the blade, a new tooth is started on top of the worn one. The operating characteristics of the Denver Road File are capable of wide modification, thus the tooth projection ranges from as high as 1-inch for tearing up dirt roads down to ¼-inch or less for use on sand or oil tops where only a light blading action is desired. The angle of travel is adjustable to suit road travel with the traffic or against it, and to blade material towards or away from the road center.

The Denver Road File is a sectionalized tool and can be assembled in any width ranging from 5 feet as used on narrow dirt roads up to 10 or 12 feet as used on broad highways. Standard equipment includes the Road File, a hand operated lift, draft hooks, chains and attachments for any standard truck, a set of tools and one extra set of teeth.